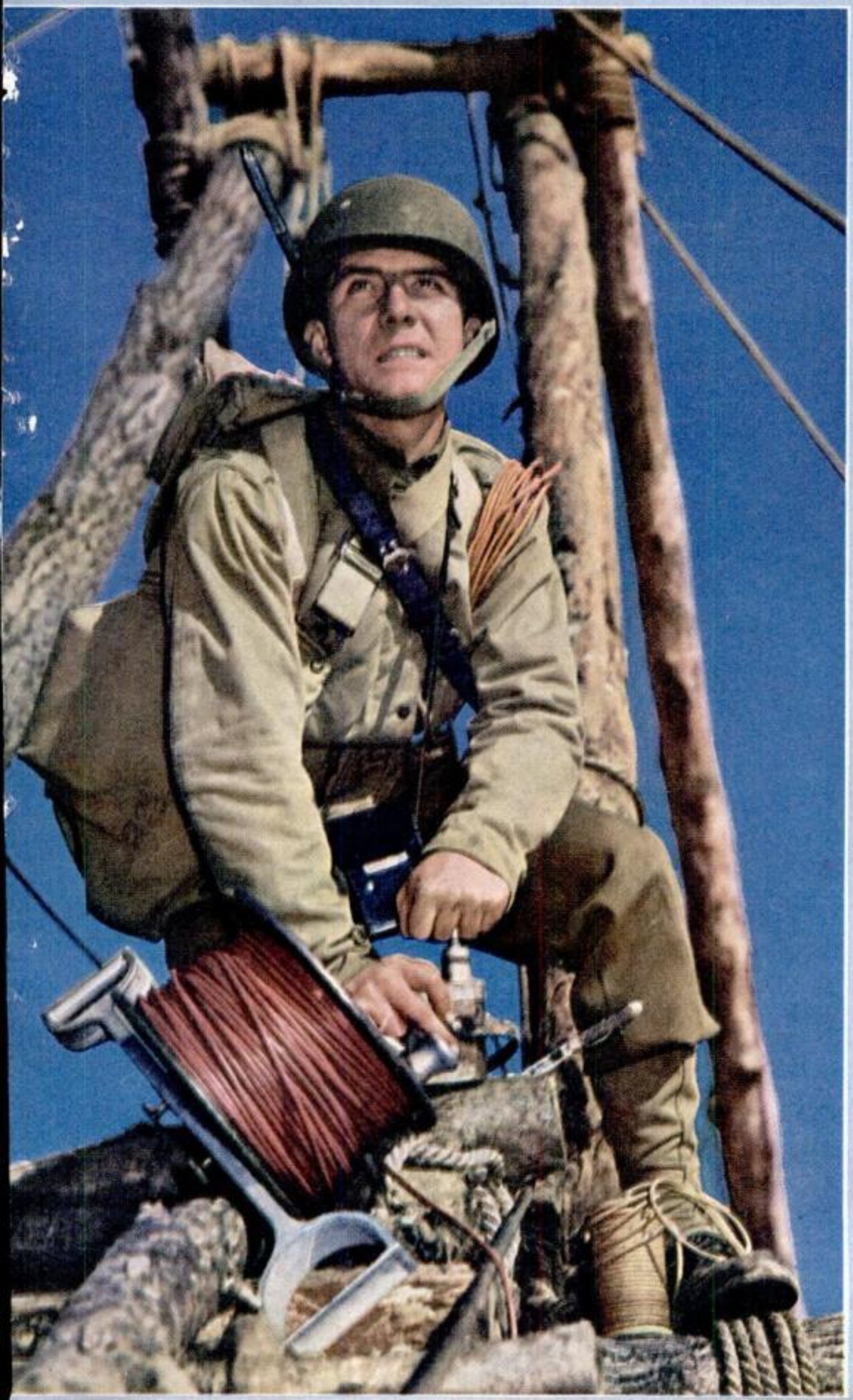
AUGUST 20¢

POPULAR SCIENCE

MONTHLY



For Freedom's Sake
. . . Buy War Bonds

Body blow *by Fisher*

First in the automotive industry to fly the Navy "E" with three stars, Fisher has also been awarded the Army-Navy "E" for its ahead-of-schedule tank production.

It's bad news for enemy planes—this 90-millimeter anti-aircraft gun.

Here are a few notes for the record—time and place deleted.

A four-gun battery of these "nineties" brought down sixteen high-altitude bombers in twelve days.

"Body blow" was right!

Fisher is proud of this gun, although Fisher did not make *all* of it. Like most armament, it is a fine example of the cooperative spirit of American industry, with many manufacturers contributing to the finished product.

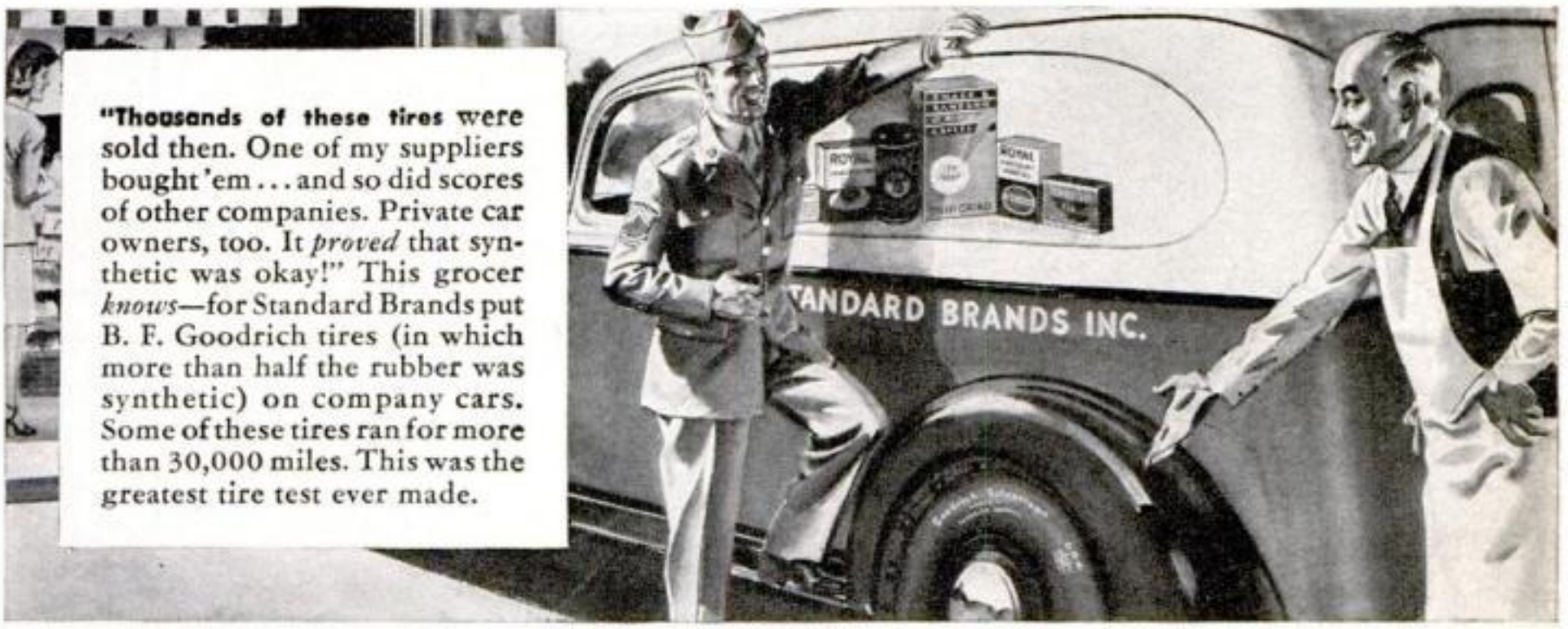
Perhaps Fisher's most notable contribution to this national effort is craftsmanship well directed. Precision men and precision methods help to give Fisher tanks, bombers, anti-aircraft guns and delicate aircraft instruments a technical plus. All the unusual crafts and special skills we have developed are trained on this target.

In war as in peace, craftsmanship is our goal. And we do our best to make the Fisher name on armament mean an ace in the hole when the going gets tough.

armament BODY BY *Fisher*

DIVISION OF GENERAL MOTORS

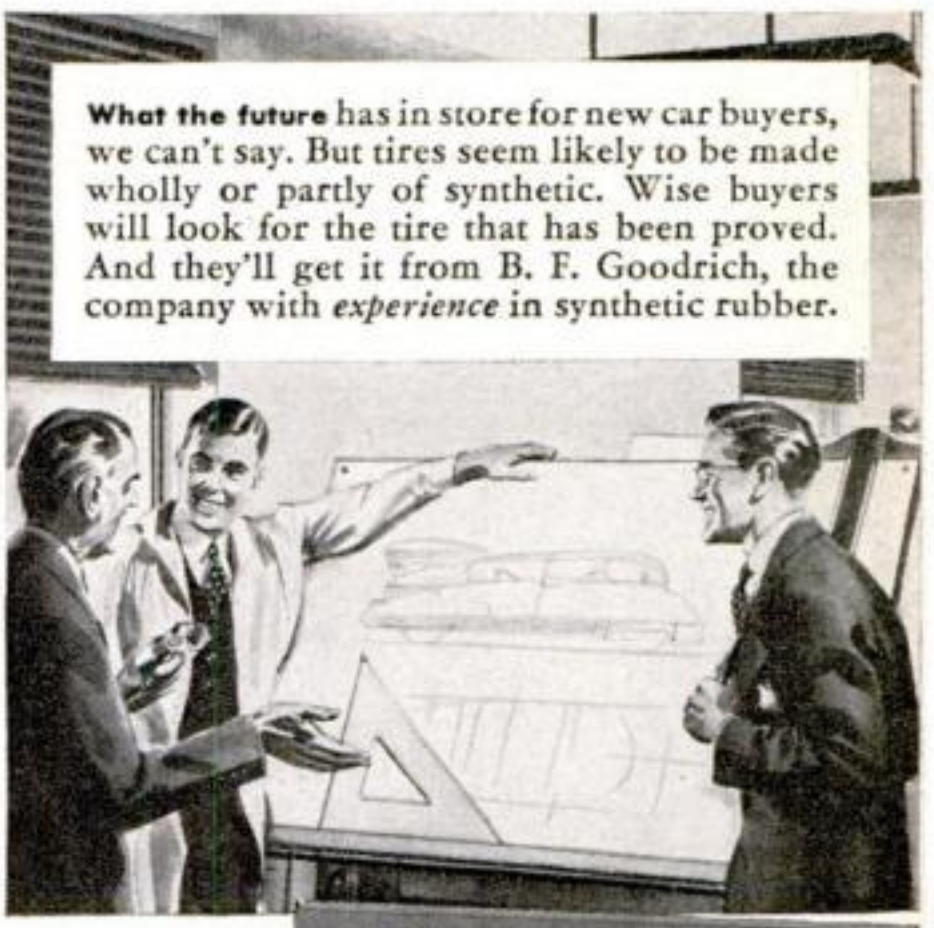
'WAY BACK IN 1940, THEY WERE RUNNING ON B.F.GOODRICH SYNTHETIC TIRES



"Thousands of these tires were sold then. One of my suppliers bought 'em . . . and so did scores of other companies. Private car owners, too. It *proved* that synthetic was okay!" This grocer *knows*—for Standard Brands put B. F. Goodrich tires (in which more than half the rubber was synthetic) on company cars. Some of these tires ran for more than 30,000 miles. This was the greatest tire test ever made.

Your War Bonds help to pay for the synthetic rubber used by our armed forces. Jeeps run on it, fighter planes land on it, and guns move on it. Synthetic rubber is used in self-sealing fuel tanks for planes, too. That's why everybody can't have synthetic rubber tires now.

What the future has in store for new car buyers, we can't say. But tires seem likely to be made wholly or partly of synthetic. Wise buyers will look for the tire that has been proved. And they'll get it from B. F. Goodrich, the company with *experience* in synthetic rubber.



LISTEN TO JOSEPH C. HARSCH
in "THE MEANING OF THE NEWS"

OVER THE COLUMBIA BROADCASTING SYSTEM EVERY NIGHT, MONDAY THROUGH FRIDAY

Inside Information by a man who has lived where the news is being made

In war or peace

B.F.Goodrich

FIRST IN RUBBER

MASTER OF MANY CLIMES

You will find the Allison engine busy today in tropic heat and numbing cold. ★ You will find it strafing the enemy through the ground haze of the desert—you will meet it, too, in the sub-arctic temperatures of the upper air. ★ But wherever you find it, you find sturdy dependability doing a masterful job, carrying the fighting pilots of the United Nations successfully on their missions—then winging them safely home again. ★ The Allison is manufactured under General Motors standards of engineering, metallurgy and fabrication. ★ Planned from the outset to be one of the world's finest aircraft engines, the Allison is living up to General Motors' purpose in creating it—and in the process proving itself master of every climatic condition under which men fight.

LIQUID-COOLED AIRCRAFT ENGINES

POWERED BY ALLISON

P-38 — Lightning
P-39 — Airacobra
P-40 — Kittyhawk
P-51 — Mustang

Allison

DIVISION OF GM GENERAL MOTORS

Popular Science Monthly for August, 1943, Volume 143, Number 2. Published monthly at 353 Fourth Avenue, New York 10, N. Y., by Popular Science Publishing Co , Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Yearly subscriptions to the United States, **$2.00.**

ONE great American army is still open for enlistments! It's the all-important army of *trained men* — whose *specialized* knowledge and skill are helping to win the war *today*, and will play a vital role in the victory world of *tomorrow!*

You still have time to join these "industrial rangers." Even if you're over 38 — or over 50! — training will make you a better fighter on the production front, and will fit you for a better job when peace comes.

You can get your training as thousands of business and industrial leaders got theirs — by studying a low-cost I. C. S. Course in your spare time, at home! 400 business and technical subjects to choose from — one, or a combination of several, will fit you for greater success.

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FREE! ***Mail coupon and we will send you free sample lesson in Shop Practice.***

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POPULAR SCIENCE

FOUNDED 1872 MONTHLY VOL. 143 NO. 2

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

CONTENTS *for* AUGUST, 1943

News

Automobiles

Home and Workshop

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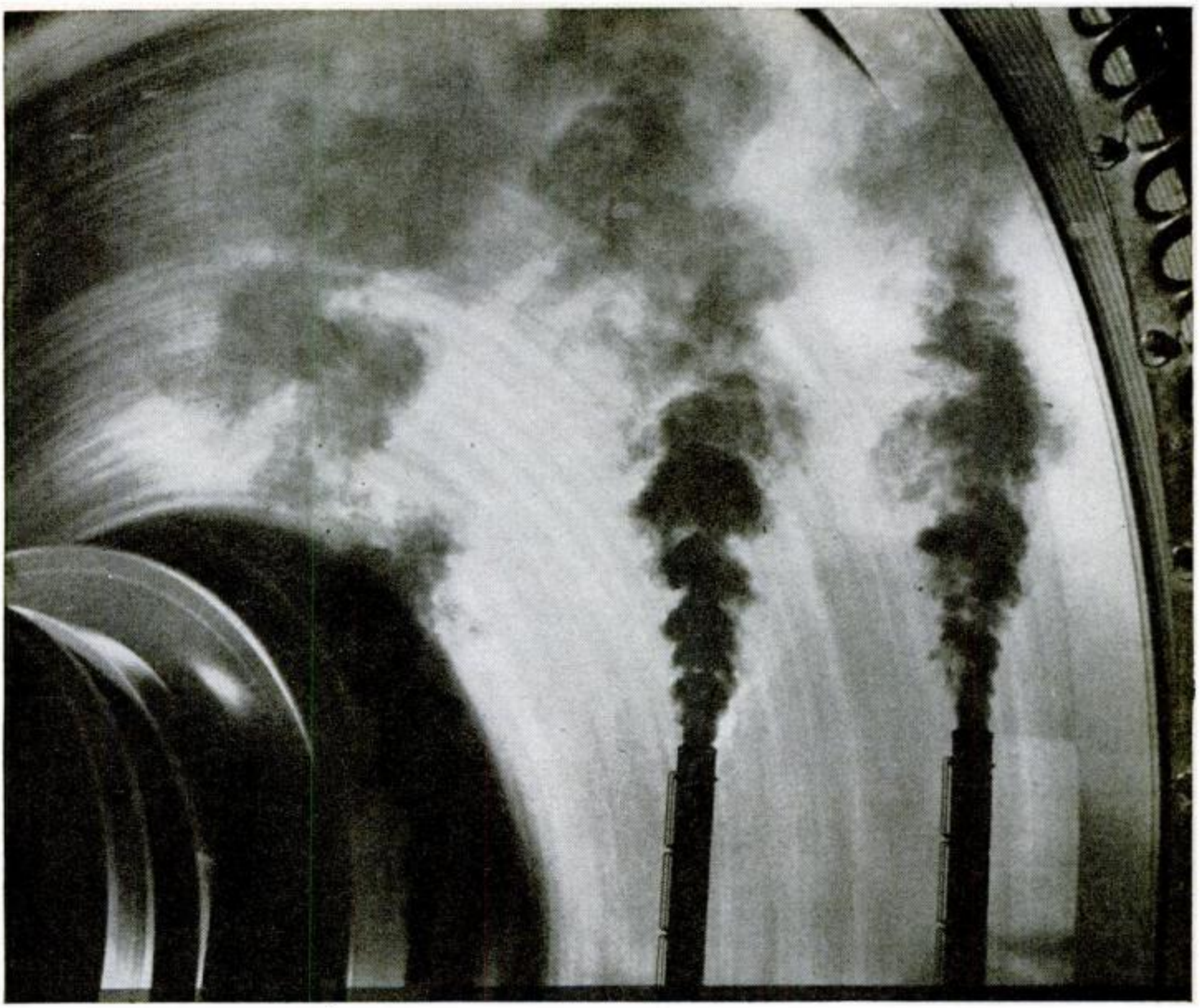
OUR COVER photograph is a Kodachrome of a demolition engineer—one of the men who will blast a path for the advance into Hitler's Europe. In this action shot he is using a small portable magneto to set off a charge of TNT. Armed with satchels of high explosive, such artists in destruction will be in the vanguard of invasion, helping to smash enemy installations, block counterattacks by hostile tanks, and reduce fortifications by direct assault. Photo by courtesy of Corps of Engineers, U.S. Army. The aluminum ink used in the background of the cover design was on hand before Pearl Harbor and could not be converted to war-industry use.

Published monthly at 353 Fourth Avenue, New York 10, N. Y., by Popular Science Publishing Co., Inc Godfrey Hammond, President and Treasurer; R. C. Wilson, Raymond J. Brown, Charles McLendon, Stephen P. Glennon, Vice-Presidents; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A.

Yearly subscriptions to United States and its possessions, $2.00; Canada, $2.50; foreign countries, excepting Canada, $3.00. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address.



A LOT GOING ON IN THIS PICTURE—

AND A LOT GOING ON IN INDUSTRY

It's big, dramatic. You can see it. But you can't see the idea that made it.

You can't photograph ideas. But they win wars. They make jobs. They make prosperity. They make well-being.

They used to come as a revelation once in a while, almost like a miracle to an individual. Now, there are teams that insure them.

Groups that keep ideas flowing. People who know how to dip into the wealth of nature for what they need.

They are scientists. They work together in laboratories.

They are working at the Bell Telephone Laboratories. Thousands of them. This is the biggest industrial laboratory in the world. Once its work was all telephone. To help your voice reach any one, anywhere. Easily, quickly, at low cost. Now it's war. Day and night. Seven days a week.

Our fighting men see the results of American research every day.

BELL TELEPHONE SYSTEM

Help the war by making only vital calls to war-busy centers. That's more and more essential every day.

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NEW WPB ORDER MAY ENTITLE YOU TO WORLD'S FINEST ANTI-FREEZE

The War Production Board, by its recent Limitation Order, has prohibited the sale of "Prestone" anti-freeze for use in passenger cars, station wagons and taxis. The purpose of the order is to free for more essential uses the supply of ethylene glycol base anti-freeze left over by the armed forces.

IF YOU'RE ELIGIBLE—GET YOURS NOW

War supply hazards being what they are, the prudent operator will lay in his next winter's supply of "Prestone" anti-freeze *right now, this summer.* This is the one way you can be absolutely sure of having an adequate supply when the cold weather starts.

IF YOU OWN A DELIVERY

truck or service fleet, the order makes you eligible for the all-winter protection of "Prestone" anti-freeze. Put it in and stop worrying about winter breakdowns and the shortage of replacement parts.

IF YOU OWN A BUS . . .

"Prestone" anti-freeze can help you keep war workers on a war schedule. Special ingredients in "Prestone" anti-freeze protect against rust, corrosion—a protection against parts replacement.

SAME PRODUCT AS ALWAYS

IF YOU OWN A TRACTOR

working either for industry or for America's vast farming program, you can insure it against winter with "Prestone" anti-freeze. The same applies to stationary engines and all construction equipment.

IF YOU OWN A TRUCK,

you are eligible for "Prestone" anti-freeze to keep essential wheels moving. No need to idle your engine during winter stops to avoid freeze-up—"Prestone" anti-freeze saves you precious gasoline!

ONE SHOT LASTS ALL WINTER YOU'RE SAFE AND YOU KNOW IT!

PROTECTS AGAINST RUST AND CORROSION!

It can't evaporate or boil away!

It creates no fire hazard!

PRESTONE ANTI-FREEZE

TRADE MARK

Contents [CONTINUED]

Craftwork

Electrical

Home Building

Miscellaneous

New Shop Ideas

Outdoors

(Continued on page 10)

Hold a new world in your hands!

• Electronic tubes are figuring in every battle of this war. Peace will find us in a new World of Electronics as secret wartime applications are turned to new uses revolutionizing all our ways of living.

• The future applications of electronics in industry literally are limitless. The *trained* man holding an electronic tube actually is holding a whole new world in his hands.

• The appeal of electronics is to men of vision and imagination. If it appeals to *you*, lose no time in joining those forward-lookers who are studying electronics today. You can study the new I.C.S. Course in the Essentials of Electronics in your spare time — at low cost.

• Mark and mail the coupon—it's *your* reservation for a well-paid, responsible place in tomorrow's greater industrial world.

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Contents (CONTINUED)

Photography

Shop Data

The Handy Man

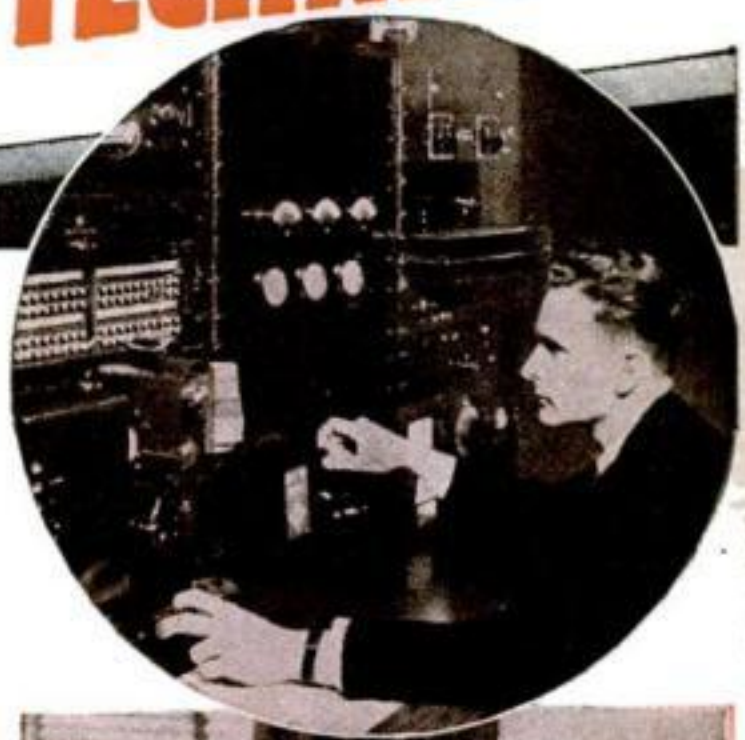
Woodworking

J. E. SMITH, President
National Radio Institute
Established 28 Years

I WILL SEND A SAMPLE LESSON FREE

to PROVE I can Train You at Home in Spare Time to

BE A RADIO TECHNICIAN



BROADCASTING **STATIONS (top illustration) employ** Radio Technicians **as operators, installation, maintenance men** and in **other fascinating, steady, well-paying technical jobs. FIXING RADIO SETS** (bottom illustration), **a booming field today, pays many Radio** Technicians **$50 a** week. **Others hold their regular jobs and make $5 to** $10 **a week extra fixing Radios in spare time.**

I Trained These Men

$200 a Month In Own Business

"For several years I have been in business for myself making around $200 a month. Business has steadily increased. I have N.R.I. to thank for my start in this field." ARLIE J. FROEHNER, 300 W. Texas Ave., Goose Creek, Texas.

$5 to $10 a Week in Spare Time

"I am engaged in spare time Radio work. I average from $5 to $10 a week. I often wished that I had enrolled sooner because all this extra money sure does come in handy." THEODORE K. DuBREE, Horsham, Pa.

Lieutenant in Signal Corps

"I cannot divulge any information as to my type of work, but I can say that N.R.I. training is certainly coming in mighty handy these days." (Name and address omitted for military reasons.)

MAIL the Coupon for a FREE lesson from my Radio Course. It shows how N.R.I. trains you for Radio at home in spare time. And with this Sample Lesson I'll send my 64-page illustrated book, "Win Rich Rewards In Radio." It describes many fascinating jobs Radio offers, tells how you can train for them at home in spare time.

More Radio Technicians and Operators Now Make $50 a Week Than Ever Before

There's a big shortage of capable Radio Technicians and Operators because so many have joined the Army and Navy. Fixing Radios pays better now than for years. With new Radios out of production, fixing old sets, which were formerly traded in, adds greatly to the normal number of servicing jobs.

Broadcasting Stations, Aviation and Police Radio, Ship Radio and other communications branches are scrambling for Operators and Technicians to replace men who are leaving. You may never see a time again when it will be so easy to get started in this fascinating field. The Government too needs hundreds of competent civilian and enlisted Radio men and women. Radio factories, with huge war orders to fill, have been advertising for trained personnel. And think of the NEW jobs Television, Frequency Modulation, Electronics and other Radio developments will open after the war! This is the sort of opportunity you shouldn't pass up.

Many Beginners Soon Make $5, $10 a Week Extra in Spare Time

There's probably an opportunity right in your neighborhood to make money in spare time fixing Radios. I'll give you the training that has started hundreds of N.R.I. students making $5, $10 a week extra within a few months after enrolling. The N.R.I. Course isn't something just prepared to take advantage of the present market for technical books and courses. It has been tried, tested, developed, perfected during the 28 years we have been teaching Radio.

Find Out What N.R.I. Can Do for YOU

MAIL COUPON NOW for FREE Sample Lesson and 64-page illustrated book. You'll see the many fascinating jobs Radio offers and how YOU can train at home. If you want to *jump your pay—mail Coupon at once* in an envelope or paste on a penny postal! **J. E. SMITH, President, Dept. 3HP3, National Radio Institute, Washington 9, D.C.**

TRAINING MEN FOR VITAL RADIO JOBS

Extra Pay in Army, Navy, Too

Men likely to go into military service, soldiers, sailors, marines, should mail the Coupon Now! Learning Radio helps Service men get extra rank, extra prestige, more interesting duties, MUCH HIGHER PAY. Also prepares for good Radio jobs after service ends. Over 1,700 Service men now enrolled.

Mail Coupon Now!

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE

MR. J. E. SMITH, President, Dept. 3HP3
NATIONAL RADIO INSTITUTE, Washington 9, D. C.

Mail me FREE without obligation, Sample Lesson and 64-page book, "Win Rich Rewards in Radio." (No Salesman will call. Write plainly.)

Age .....

Name .....

Address .....

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Coming Next Month

INVASION is paced by the fort-busters, specially trained destruction engineers who use TNT, flame, and naked valor to blast a path through formidable steel-and-concrete defensive works. Read about these demolition men and the tricks they have up their camouflaged sleeves for shattering the ramparts of Hitler's shaky "Fortress Europe."

WHERE WILL YOU LIVE AFTER THE WAR? In a modern, prefabricated house with every comfort and convenience for streamlined living, according to Carl T. Sigman and William J. Ward, Jr. They give you a preview of the home you will receive as a by-product of the war when arms plants turn their machines to the tasks of peace.

SMALL CARVING MOTORS lend themselves admirably to precision woodworking, with the aid of easily built stands. How these stands are made and used for such jobs as rabbeting, routing, and veining is told in an article that will delight any woodworker. Even in the building of full-sized furniture, the small motor or flexible shaft can perform valuable service.

"THAT FORK-TAILED DEVIL" is the way German pilots bitterly describe our P-38 fighter plane. On every front of the war, the Axis has learned to respect this queer-looking, fast Lockheed job. You'll want to know the history of the P-38 and the features of design and construction that have made it a telling factor in the war in the air.

NATURE'S BLITZKRIEG, the lightning, isn't nearly the formidable thing it used to be. Experiments with man-made thunderbolts, and other research, have revealed hitherto unknown facts about its behavior, with the result that vital power lines and munitions plants can now be protected effectively against sabotage from the sky.

NO RATION COUPONS are required for the enjoyment of the great outdoors, but careful planning and preparation are necessary if your camping trip is to be comfortable and pleasant. Jack Hazzard gives some practical suggestions on equipment and technique for anything from a short hike to a lengthy sojourn in the wilderness.

How to Make YOUR Body Bring You FAME

...Instead of SHAME!

ARE YOU Skinny? Weak? Flabby?

Will You Let Me Prove I Can Make You a New Man?

I KNOW what it means to have the kind of body that people pity! Of course, you wouldn't know it to look at me now, but I was once a skinny weakling who weighed only 97 lbs.! I was ashamed to strip for sports or undress for a swim. I was such a poor specimen of physical development that I was constantly self-conscious and embarrassed. And I felt only HALF-ALIVE.

But later I discovered the secret that turned me into "The World's Most Perfectly Developed Man." And now I'd like to prove to you that the same system can make a NEW MAN of YOU!

What Dynamic Tension Will Do For You

I don't care how old or young you are or how ashamed of your present physical condition you may be. If you can simply raise your arm and flex it I can add SOLID MUSCLE to your biceps —yes, on each arm—in double-quick time! Only 15 minutes a day—right in your own home—is all the time I ask of you! And there's no cost if I fail.

I can broaden your shoulders, strengthen your back, develop your whole muscular system INSIDE and OUTSIDE! I can add inches to your chest, give you a vise-like grip, make those legs of yours lithe and powerful. I can shoot new strength into your old backbone, exercise those inner organs, help you cram your body so full of pep, vigor and red-blooded vitality that you won't feel there's even "standing room" left for weakness and that lazy feeling! Before I get through with you I'll have your whole frame "measured" to a nice new, beautiful suit of muscle!

Only 15 Minutes A Day

No "ifs," "ands" or "maybes." Just tell me where you want handsome, powerful muscles. Are you fat and flabby? Or skinny and gawky? Are you short-winded, pepless? Do you hold back and let others walk off with the prettiest girls, best jobs, etc.? Then write for details about *"Dynamic Tension"* and learn how I can make you a healthy, confident, powerful HE-MAN.

"Dynamic Tension" is an entirely NATURAL method. Only 15 minutes of your spare time daily is enough to show amazing results—and it's actually fun. *"Dynamic Tension"* does the work.

"Dynamic Tension!" That's the ticket! The identical *natural* method that I myself developed to change my body from the scrawny, skinny-chested weakling I was at 17 to my present super-man physique! Thousands of other fellows are becoming marvelous physical specimens—my way. I give you no gadgets or contraptions to fool with. When you have learned to develop your strength through *"Dynamic Tension,"* you can laugh at artificial muscle-makers. You simply utilize the DORMANT muscle-power in your own body—watch it increase and multiply into real, solid LIVE MUSCLE.

My method—*"Dynamic Tension"* —will turn the trick for you. No theory—every exercise is practical. And, man, so easy! Spend only 15 minutes a day in your own home. From the very start you'll be using my method of *"Dynamic Tension"* almost unconsciously every minute of the day—walking, bending over, etc.—to BUILD MUSCLE and VITALITY.

FREE BOOK "EVERLASTING HEALTH AND STRENGTH"

In it I talk to you in straight-from-the-shoulder language. Packed with inspirational pictures of myself and pupils—fellows who became NEW MEN in strength, my way. Let me show you what I helped THEM do. See what I can do for YOU! For a real thrill, send for this book today, AT ONCE. CHARLES ATLAS, Dept. 18, 115 East 23rd Street, New York 10, N. Y.

Charles Atlas

Holder of title, "The World's Most Perfectly Developed Man." As he looks today, from actual untouched snapshot.

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115 East 23rd Street, New York 10, N. Y.

I want the proof that your system of *"Dynamic Tension"* will help make a New Man of me—give me a healthy, husky body and big muscle development. Send me your free book, "Everlasting Health and Strength."

Name .....
(Please print or write plainly)

Address .....

City ..... State .....

☐ Check here if under 16 for Booklet A

IN A TAPERED ROLLER BEARING

Count the rolls... ...the rolls count!

☆ When a job calls for a bearing of extra capacity and life, call on Tyson Cageless. Where loads are heavy and the going is tough, use Tyson, the "All-Rolls" Bearing.

In a tapered roller bearing, *rolls carry the load*. Thanks to improved design, Tyson has *more* load-carrying rolls. These extra rolls mean greater capacity . . . longer bearing life . . . maximum rigidity.

Tyson "All-Rolls" Bearings are interchangeable with tapered roller bearings of lesser capacity and shorter life.

For every heavy-duty application, ask for Tyson. It pays.

Tyson

TYSON BEARING CORPORATION
MASSILLON, OHIO

HEAVY-DUTY BEARINGS

Tyson Products also include precision parts for America's airplane engines

_turn their binoculars this way!

IN a wave-tossed rubber raft, survivors from a lost plane count ahead: How many more days will food and water last? Count back: How many days have they drifted—*away* from possible rescue? Count their chances to live!

Then—so far off, it can hardly be identified as one of our own—a single plane.

Saved? Not yet!... *Only with binoculars could the men in the plane possibly see them.*

Those on the raft, fliers themselves, know that. Fear that those up there who are using binoculars are too intent on sighting their objective to spot that tiny raft.

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Readers Say:

Calling Dr. Nostradamus! You're Wanted in Congress

IN THE "Readers Say" for June there is a reference to the prophet Nostradamus, and to a previous reference which was supposed to have appeared in your February issue. I am secretary to a member of the House of Representatives and I am very much interested in the prophecies of Nostradamus. I went carefully through the February issue, but was unable to find this article. Can you enlighten me as to the correct issue?—C. S. G., Washington, D. C.

We printed not an article but a letter which we received on the predictions of the famous Dr. Nostradamus. This letter, which is one of several that we have published on this subject, appears on page 18 of the February issue.—Ed.

Mail Carrier Converts Ford to Half-Track

I WOULD like to call your attention to a novel vehicle built by a mail carrier in northern Illinois. This vehicle has been built to travel over winter snows and through spring mud. Nicknamed the "Snow Bird," it consists of a Ford sedan on which a wheel has been placed in front of, and in back of, each rear wheel, so that there are three rear wheels on either side. Each set of three wheels is equipped with a tractor tread, the front wheels remaining as they are, so that the whole thing looks very similar to an Army half-track. Protruding a little ahead of the front wheels, and suspended a few inches off the ground, are a pair of skis—one near the inside rim of each front wheel. The "Snow Bird" can attain a speed of 40 miles an hour, can climb snow drifts four and five feet deep, and can slosh through knee-deep mud. I am bringing it to your attention as I believe some of your readers may be interested to know of such a device.—F. L. S., Decatur, Ill.

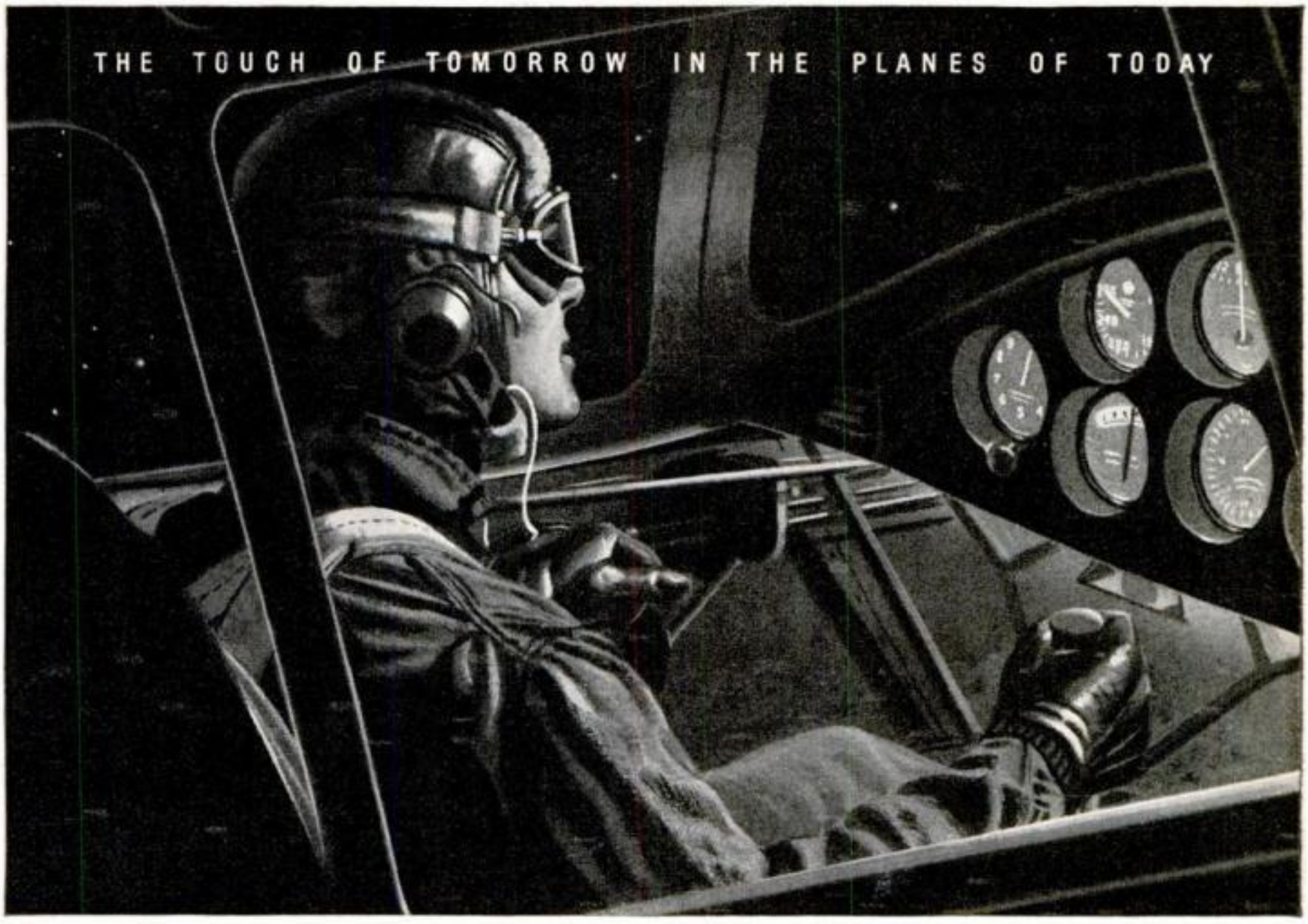
Navy Welder Sweats Over a Melting Point

I AM A first-class metalsmith and have been in the Navy for seven years, during which time I've done a great deal of electric and oxyacetylene welding. Now I have a problem that I would like to have some metallurgist among your readers solve for me. The melting point of tin is 450 degrees F., and that of lead is 621 degrees F. Yet it is possible to combine the two and make an alloy with a melting point that is even lower than that of tin. This alloy, containing 31 percent lead and 69 percent tin, has a melting point of only 356 degrees F., or 94 degrees lower than tin's. Can any of your readers explain this curious phenomenon? Also I would like to know what is the melting point of an alloy made up of lead and tin in equal parts? No two authorities seem to agree on this question?—A. M., MI/C, U. S. S. Dixie, 7th Division, c/o Fleet Post Office, San Francisco, Calif.

A mixture of 50 percent tin and 50 percent lead melts at 428 degrees F., according to the Smithsonian Physical Tables. As to your other question, we suggest you query the National Bureau of Standards who, we understand, are full of explanations for such curious phenomena.—Ed.

Swimmers Are Warned Not To Bump Their Heads

AS A SERIOUS student of physics, I was amazed to hear a neighbor of mine state that the *Titanic* (the famous ship which piled up on an iceberg some years ago) had not sunk to the bottom of the ocean but to only a few feet below the surface because of its many airtight compartments. It is my neighbor's contention that this great ship is still floating around at this slight depth. I would like you to publish this so that physicists and scientists can clarify this problem once and for all.—E. C. H., Pittsford, N. Y.



War Is a Skill Our Sons Must Learn

Every American soldier fights with courage and self-sacrifice. But these alone do not win wars. War also demands high technical skill because it is a struggle not only of men against men, but also of machine against machine—tanks, planes, battleships. Without training in the use of these instruments of war, soldiers today are without weapons!

One weapon in this war—the airplane—calls for more personal skill than any other. And one of the most critical phases in a pilot's training is his step-by-step transition from primary trainers to combat planes. These steps cannot be abrupt, yet time demands that they be swift. Therefore, along with the relative stability and safety required in a training plane, Fairchild engineered into its trainers certain definite characteristics of the combat plane. Thus, they get a pilot ready for his second step while teaching him the first!

Fairchild training planes—primary trainers, bomber crew trainers and gunnery trainers—are being used on United Nations training fields throughout the western hemisphere. They are powered by Fairchild Ranger aircraft engines. They reflect the 20 crowded years which Fairchild engineers have devoted to "creating the plane for the purpose." The "touch of tomorrow" in Fairchild engineering indicates courage to try new things. We shall need many new things to further prosecute this war against our resourceful enemies. Fairchild has quite a number on the way—to add to those already on its record!

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Readers Say:

He's in Hot Water Even When There Isn't Any

THERE are so many uses for old X-ray film when they have been cleaned that I am wondering if any readers know of a faster way of cleaning than that of soaking them in hot water. It so happens, in fact, that I seldom have even hot water, and so I am put to a lot of trouble cleaning the film. If anyone has a solution, I wish he would pass it along.—J. A. K., Nashville, Tenn.

His Old Flashlight Cells Get a New Lease on Life

I NOTE in your February issue a request from S. G. of Philadelphia, Pa., as to what use he can make of his 50 burned-out flashlight batteries. He might be interested in my method of recharging. I simply punch a small hole in the side of the battery and then let the cell soak in water for about 10 minutes. I then dry it off, put a piece of adhesive tape over the hole, and the battery is ready for use again.—R. G., Newark, N. J.

Doesn't Smoke, Drink, or Lie Down in Tar

ONCE a month you cost me a night's sleep, for every time your magazine appears on the newsstands I sit up all night reading the issue from cover to cover. But it's worth it. However, those wiseacres in "Readers Say" give me a pain in the neck, especially when they start explaining why it is that a dog always turns around a few times before lying down. Ever since I was knee-high to a grasshopper I have known that a dog, in turning around, is merely surveying his proposed napping place to make sure that there are no sharp objects to puncture his hide or some substance like tar to injure his coat. You never see a dog's coat soiled by something he has carelessly laid down in. Also, he has too much self-respect to injure his insides by drinking alcohol or smoking cigarettes.—A. C. W., Savannah, Ga.

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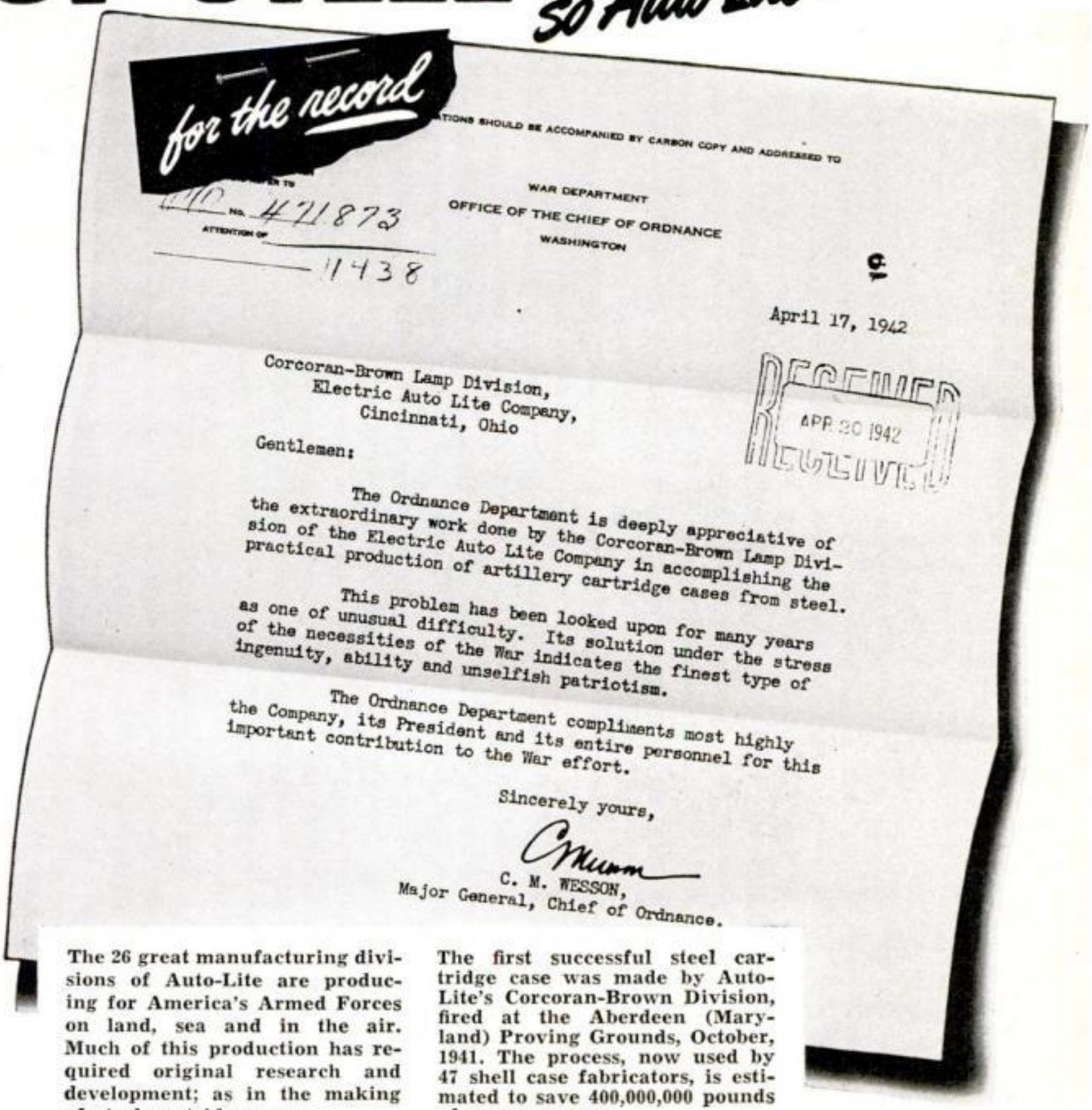

The 26 great manufacturing divisions of Auto-Lite are producing for America's Armed Forces on land, sea and in the air. Much of this production has required original research and development; as in the making of steel cartridge cases.

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Readers Say:

Can You Make His Pipe Dream Come True?

AS A READER of P. S. M., I have from time to time received numerous suggestions from your magazine which have proved very helpful in solving various problems. I am now confronted with one which really has me stumped. As you know, fuzzy pipe cleaners are off the market for the duration, and so I am writing to inquire if some of the highbrows whose letters appear in "Readers Say" can suggest some solution to this particular shortage. I tried using the hot-water faucet in the kitchen—but was promptly thrown out, pipe and all. My pipe is pretty important to me, and I dream of the time when the war will be over and I will be able once again to keep it in good working order.—E. A. R., Rye, N. Y.

Detecting the Bogus Army Officer

IN CONNECTION with the article entitled "Beware Wartime Swindlers!" that appeared in your June issue, it is stated that crooks posing as officers of the U. S. Army may be exposed by demanding to see their "dog tags" (identification medals). Possession of a dog tag is not positive proof of an officer's genuineness, for such a tag is often found, or can be stolen. Also a dog tag does not state the wearer's rank. And another point: it is not common knowledge that an officer's serial number includes the prefix "O" whereas an enlisted man's does not. A much more positive means of identification is a card which all officers carry. This card is a three-way folder. It contains the officer's picture, his signature, his description, the fingerprints of his right hand, his Army serial number, his rank, and the date of issue. In examining this card, note carefully the notarizing seal, which should include within its area of impression the signature and a portion of the picture. This makes it difficult for credentials of this kind to be forged.—Capt. C. E. C., Ordnance Dept., U. S. Army, Detroit, Mich.

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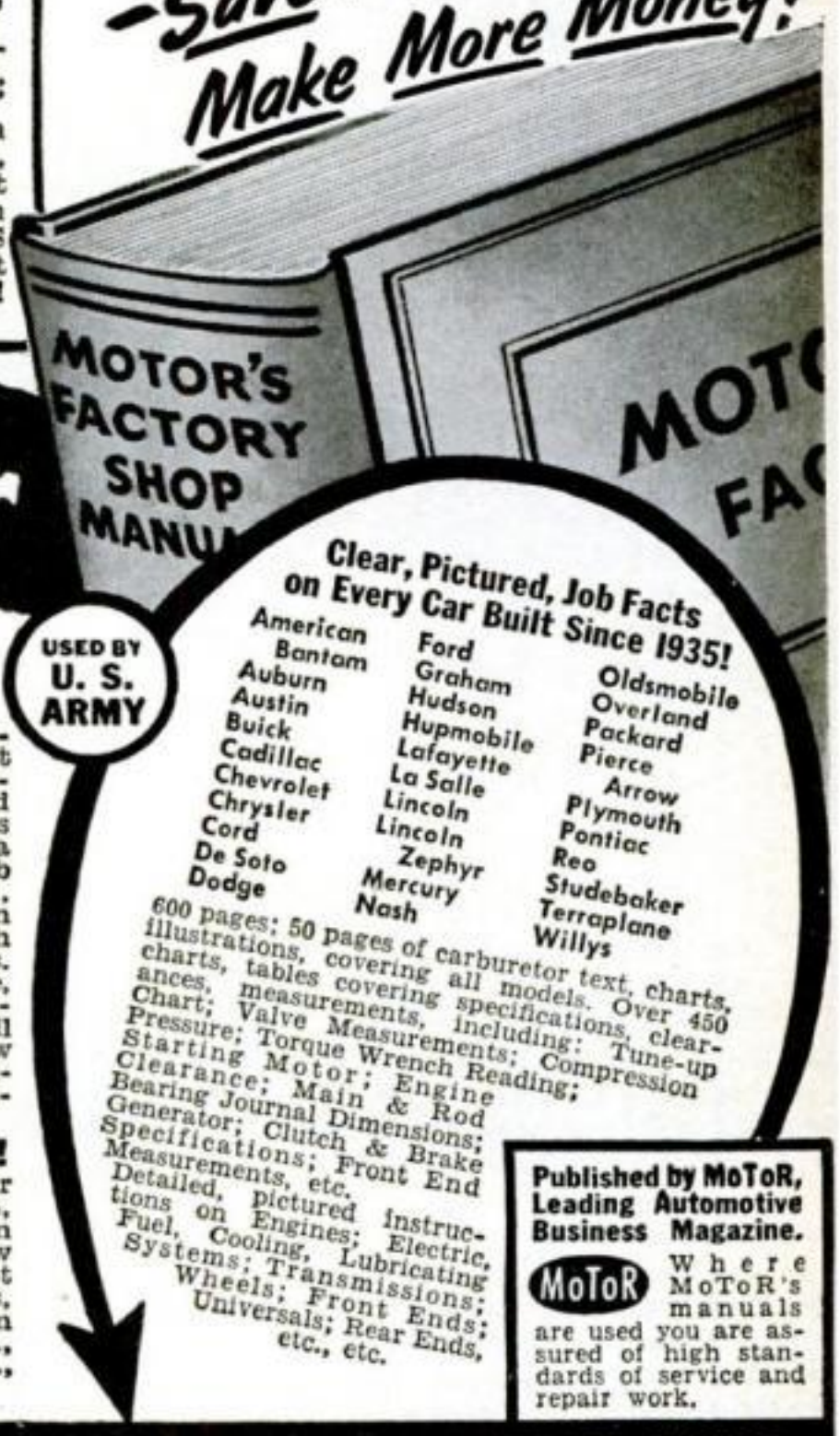

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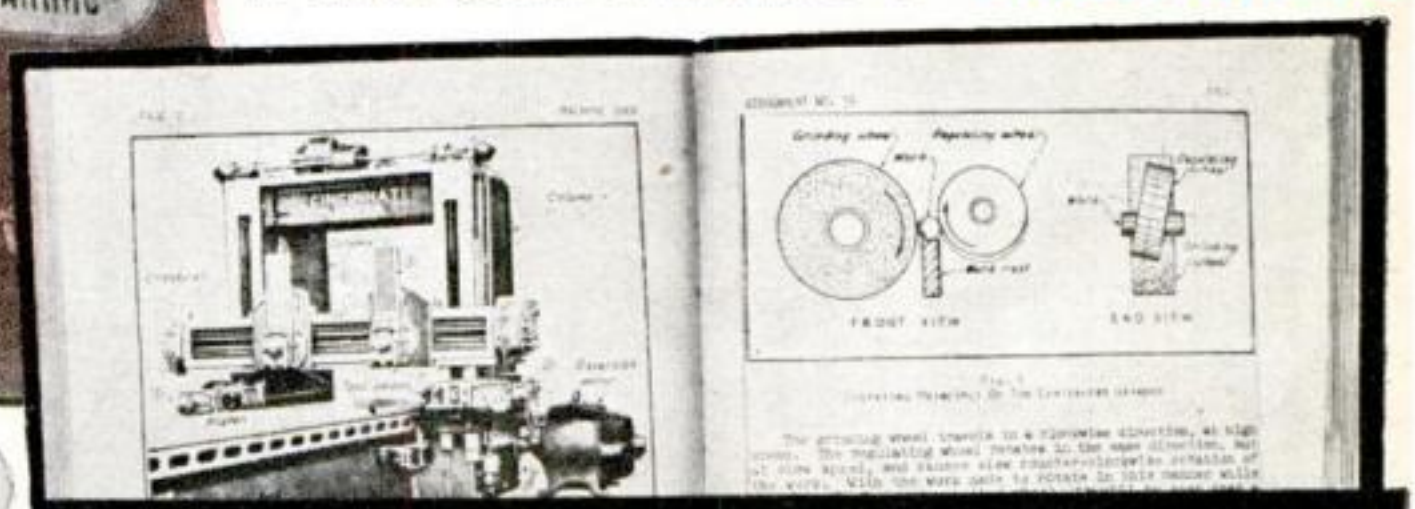

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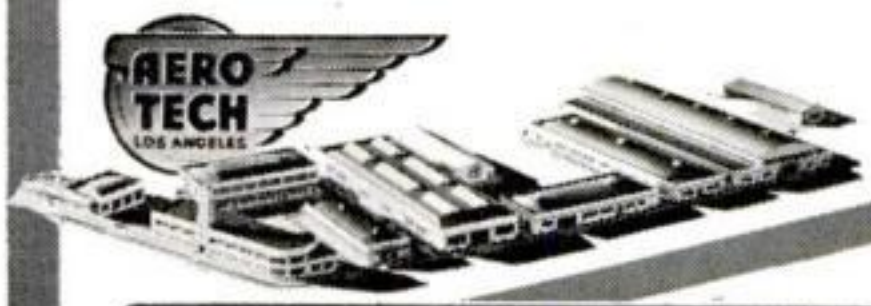

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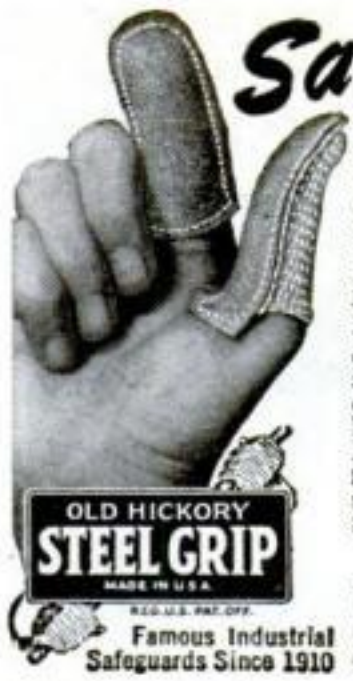

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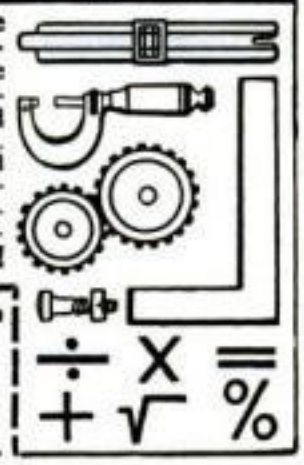

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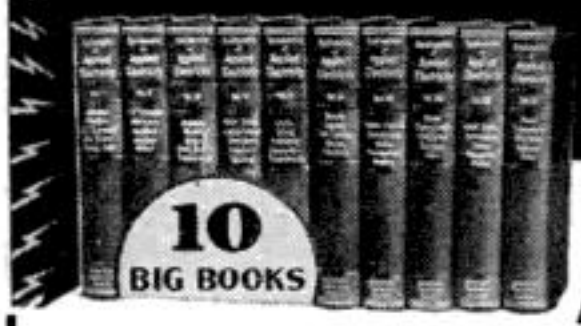

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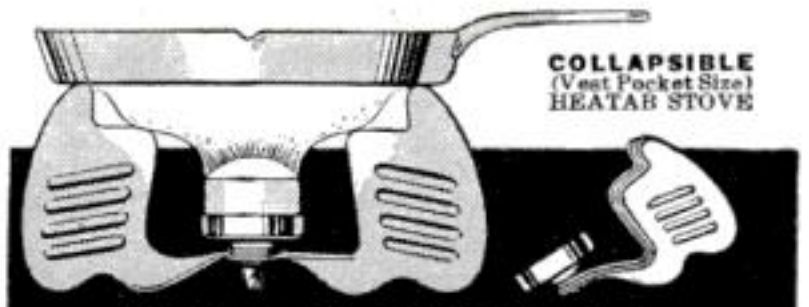

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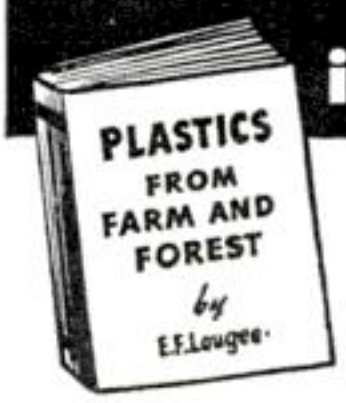

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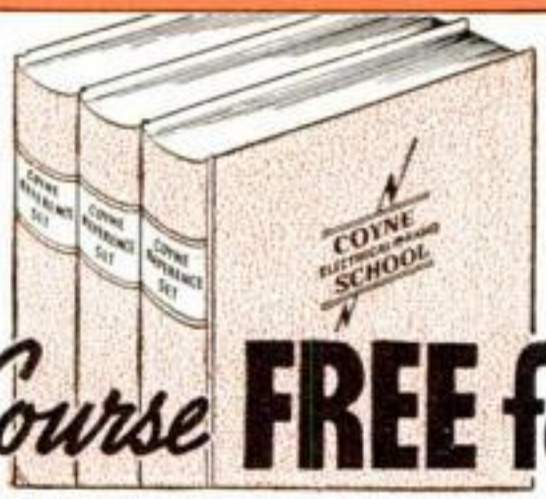

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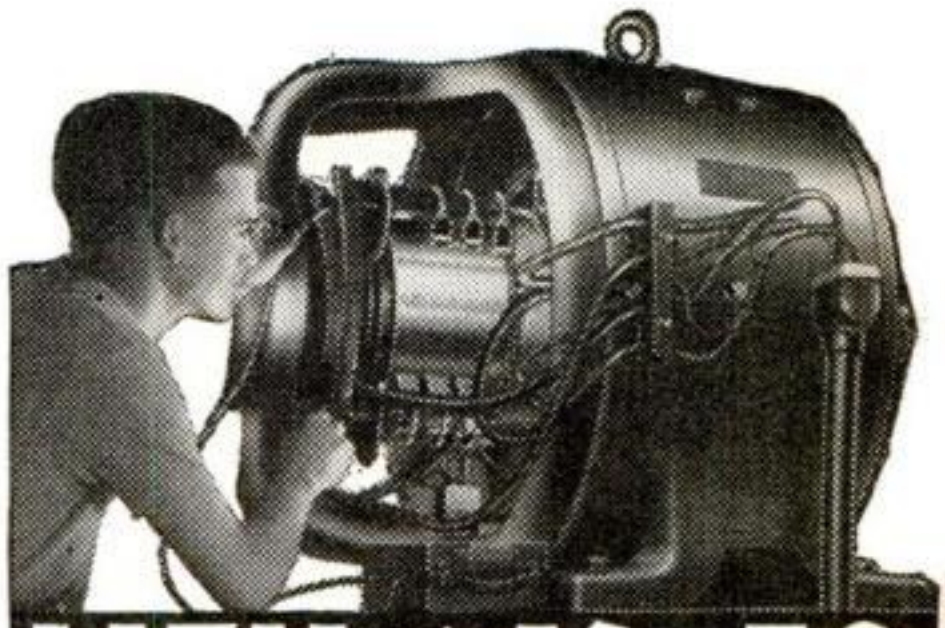

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How to Conquer Fear

Signal Corps Photo

Who's afraid? Everybody is, according to psychiatrists of the brand-new school that helps men meet the terrors of war. Here is what they have discovered to keep that empty feeling in the stomach from turning into panic.

By JACK O'BRINE

WAR is a frightening occupation for our soldiers. On every front they must be prepared not only to take what the enemy has in the way of terror, but to dish it out in bigger and stronger doses. It's a fearsome job for young men whose nearest approach to violence once was to shout, "Kill the umpire!"

But great camouflaged transports are

carrying these young men in increasing numbers to the war zones. Many already have passed months in battle sectors where all the furies of modern warfare rage. Blasting, strafing dive-bombers have howled out of a foreign sun to slice the air over their foxholes. Unholy screams of wings and motors and bombs have torn at their eardrums. Shattered rocks and flying stone have added to the threat of shrapnel. They have known lack of food and water, the tenseness of the zero hour, the sight of friends and comrades being killed and wounded before their eyes.

These former bookkeepers, clerks, farmers, and factory hands are being exposed to all the horrors of war. It makes little difference what outfit they're with—infantry, tanks, tank-busters, air forces, paratroops, engineers—they feel the fury of it. Some have cracked under the terrific strain. Authentic reports show that nearly one third of the first casualties shipped back were mental and nervous cases. But the fight goes on, with veterans, replacements, and fresh troops carrying the battle to the enemy.

Army officers are confident that our men have the stuff needed for victory. Some of that confidence stems from the belief that our soldiers have the finest and most modern equipment in the world; some comes from the knowledge that they are excellently trained, know how to use their weapons; some springs from proof of their great physical stamina, and some comes from the historical fact that American soldiers have yet to lose a war. But a factor not to be overlooked is the Army's remarkable new program to combat fear and mental instability. For this is responsible to a large degree for our success in turning millions of civilians into first-class fighting men.

From induction centers to training camps to battle areas, our soldiers are feeling the effects of the program. It's helping them to withstand the pressure of Army life on minds, nerves, and emotions. It's assisting them to be competent, dependable, courageous; and it's untangling minds that have become twisted by the stresses of war. This is the first time that such an effort has been made on a large scale.

Employed only in rudimentary form late in World War I, the process was started last year with the creation of a neuropsychiatric branch in the Surgeon General's Office in Washington. Then followed the opening of a unique school in Lawsen General Hospital, Atlanta, Ga., in which in 196 hours of classes young Medical Corps officers are being fitted for the special service. Selected with great care by Col. Roy D. Halloran, chief of the branch, and ranking

Signal Corps Photo

Medical Corps psychiatrists, they are assigned after graduation to one of the nine Army commands in this country. Later, when they are sent abroad, they work under the direction of the new neuropsychiatric centers established in the European and South Pacific theaters.

Personnel and morale officers, chaplains, and field officers assist the psychiatrists in the program. Never before has there been such co-ordination of effort to improve soldiering and make it more palatable. The psychiatrists not only watch and help individual soldiers, but they seek to create conditions wherein the stresses are minimized. They help devise means of relaxation and entertainment. They live with the troops, experience their difficulties, and help to solve them. Colonel Halloran says of them: "They are specially trained medical confidants, with a real desire and ability to help."

But even more than that, these new friends of our soldiers stand as a safeguard against one of the worst tragedies of battle—the thousands of war-induced mental cases that usually occur. For from the gateway to the Army, where an average of seven out of every 100 men up for induction are screened out as mentally unstable, to the point of embarkation, those who show tendencies to crack are sent back to their homes. In peaceful surroundings,

IN TRAINING

Realism is the secret of conditioning men's nerves for the shock and violence of battle. Here a mine shatters the air as trainees advance on a position

THE REAL THING

Nerves tense, heart thumping, this American soldier moves cautiously along a beach head, knowing that any minute he may have to kill—or be killed

those rejected men can live normal lives and prove an asset rather than a liability to our war effort.

It's at the front that the supreme test for the Army's program comes. That's the scene for the all-out fight against fear. By that time the soldier has learned many things about the science of war and wants to use that knowledge to blast the enemy. But his eagerness is mixed with dread and fright. The first time he goes into battle, he's apt to be downright scared. His throat becomes dry; his stomach feels like flipping, and his heart does a dance macabre under his khaki tunic. And that may be true every time he gets within striking distance of the enemy But he must learn to control his fear.

Experience has shown that fewer soldiers go to pieces in outfits with good morale, in winning outfits, and in well-trained outfits. It's the psychiatrists' job to maintain confidence. They know that men under fire or about to go under fire want facts, not psychiatric patter. So their tactic is to discuss fear frankly, stressing the fact that to be scared is a normal reaction shared by veterans and green troops alike—not a sign of cowardice.

Fear, as demoralizing and uncomfortable as it may be, actually is the body's preparation for action. The heart beats faster, pumping blood to the arms, legs, and brain where oxygen is needed. Quickened breathing is the part of the lungs. Blood pressure goes up, and adrenalin, nature's "shot in the arm," pours liberally into the blood stream. Sugar is released as fuel for the human fighting machine.

That's the normal reaction during the frightening moments just before an attack. Sometimes the soldier feels stunned and paralyzed, and has difficulty getting started into battle. But the Army's program of training and discipline comes to his aid, and it becomes second nature to obey commands and carry out his own job. That's why there is so much importance attached to keeping fear under control—conquering it.

The Army has six ways to fight fear. For men facing that greatest period of tenseness—just before the zero hour—the slogan is: "Work—do anything—but keep busy." Action relieves stress on minds and nerves.

Troops under fire should keep in contact with comrades, if that is at all possible. Just the presence of another man not far off helps quiet fear.

Calling the roll is helpful. It reminds the

Sights like this, of Japanese bodies mangled and broken, jangle the nerves of men who, a year before, were clerks, salesmen, farmers

men that they are part of a close-knit organization, not facing the dangers alone. Great reassurance comes with knowledge that every man is in his place, despite the smoke and din of battle, and resistance to fright mounts.

Another important remedy against fear, strange as it seems, is to keep soldiers informed of the odds confronting them. Officers are urged to keep in mind that knowledge is power over fear. Men posted on the dangers, the kind of weapons they're up against, and the size of the enemy's force are far less susceptible to fear.

Soldiers are taught that to be afraid doesn't mean they must act afraid. Since fear is contagious when it is expressed by action, men who become panicky must be removed from the sight of other men. It is the soldier's responsibility to control signs of his own fear if he can, so as to spare his comrades. Fighting men have learned that the very effort often reduces fear and brings calmness.

Soldiers are acquainted with statistics on the percentage of casualties in action. That is reassuring. For, according to figures on even the bitterest fights, comparatively few men are killed, and the chances that any one man will be among the fatally wounded in any one battle are relatively small.

The Army knows that courage and fear are not opposites—that they may be possessed by a soldier at the same time. But the soldier who has courage need not worry about his feeling of fright. He'll keep that under control. In the words of the National Research Council: "None but the brave can afford fear."

In talks that I have had with some of our wounded soldiers brought back from the war zones for treatment in the Army's great Walter Reed Hospital, in Washington, it was interesting to note how few admitted having experienced fear. One chap, who has been decorated with the Silver Star for distinguished service in North Africa, summed it up by saying: "Hell, we were too busy to get scared." His citation said that, although painfully wounded, he had pushed forward, causing enemy gunners to fire upon him and reveal their position, bringing about their defeat.

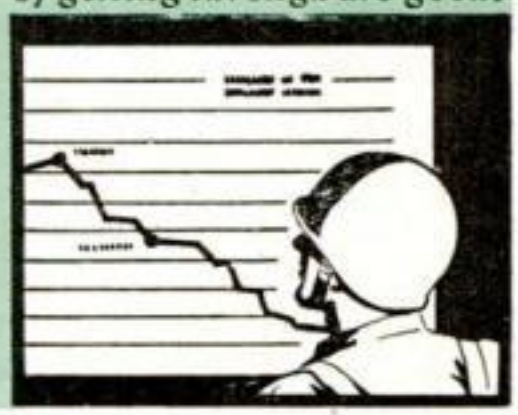
Allied soldiers take command after smashing a Jap landing barge. Dead Japs lie at their feet. Victors have the grim, calm look of seasoned troops

HERE IS WHAT A SOLDIER IS TOLD TO DO

Work. Do anything at all, but keep yourself busy. Know the odds against you —even if it's bad news.

Stay together. Another man's presence is reassuring. Try not to show your fear. It may prove contagious.

Roll call helps. It reminds a man he is part of a team. Figures show your chances of getting through are good.



This 22-year-old veteran said, however, that he and his comrades experienced a few "uneasy moments" as they were waiting orders to start the invasion. He said they showed it in funny ways. For instance, one soldier cleaned and recleaned his rifle. Another looked at his watch every few seconds, and a third couldn't seem to satisfy himself that his gun was loaded, checking it a dozen or so times.

Our young hero and his comrades may have been scared stiff, but they had learned that secret trademark of a good soldier—fear control. The magnificent thing I ran onto was the universal eagerness of the wounded to get back in the fight. They seemed to resent the fact that the boys with whom they went overseas were still in the thick of things, while they were forced to "loaf in a hospital." The Army's program has sold them on the idea that Army life, despite its hazards, is not so frightening.

That "salesmanship" is significant. For the success of neuropsychiatry is measured by the number of soldiers kept in the Army —not by the number eliminated. It's axiomatic that many of war's greatest exploits are achieved by veterans who have returned to the fight after their wounds have healed. Other valuable contributions have been chalked up by men whose first maladjustments might have wrecked their Army careers had they not been corrected. Take the case of fellows who develop jitters while on training maneuvers. These same soldiers have been transformed into first-rate cooks, mechanics, and builders who have a vital part to play in winning the war.

Those who are being shipped back from North Africa and the South Pacific as mental and nervous cases benefit greatly from the program. The neuropsychiatrists who treat them are experienced in straightening minds. They know that these casualties are not insane—that with proper treatment they will respond in a locale that has none of the dangers and fury of the fighting fronts. The trouble in most cases is that these men came from obscure little grooves in civil life, and their minds slipped when they came up against the rigors of war. Most of them will be able to return to the life they left.

As in the case of men awaiting the zero hour, the psychiatrists recommend that the neurotics be kept busy. So at Walter Reed and the other great Army hospitals you find them deeply engrossed in occupational therapy. Some make belts, ship models, chessmen; others knit or embroider. A few skilled in the arts are kept occupied with paintbrush and clay. With their hands busy, their minds have less chance of groping and strength of thought and direction seeps back.

Looking ahead to the period immediately after the war, the neuropsychiatrists appear slated for work equally as important as that in which they are now engaged. For they alone know the things about the returning soldiers that will make it possible to fit them back into civilian life. As they now are helping soldiers out of unhappy situations into niches that make soldiering endurable, they will be able to guide the veterans to happier ground. Having come from civilian life themselves, the psychiatrists will themselves return to it, and there continue to give advice and aid to the men whom they helped to lick fear and the enemy.

HOW WARPLANE MECHANICS

Talk With Their Hands

"O. K. TO START ENGINE"

"SLOW R. P. M." "INCREASE R. P. M."

"ADJUST MIXTURE" "ADJUST VACUUM"

"MIXTURE O. K. NOW" "DISCONNECT BATTERY"

"SLOW ENGINE SPEED" (WHEN TAXIING)

This upsweep of the hands means "Close bomb-bay doors"

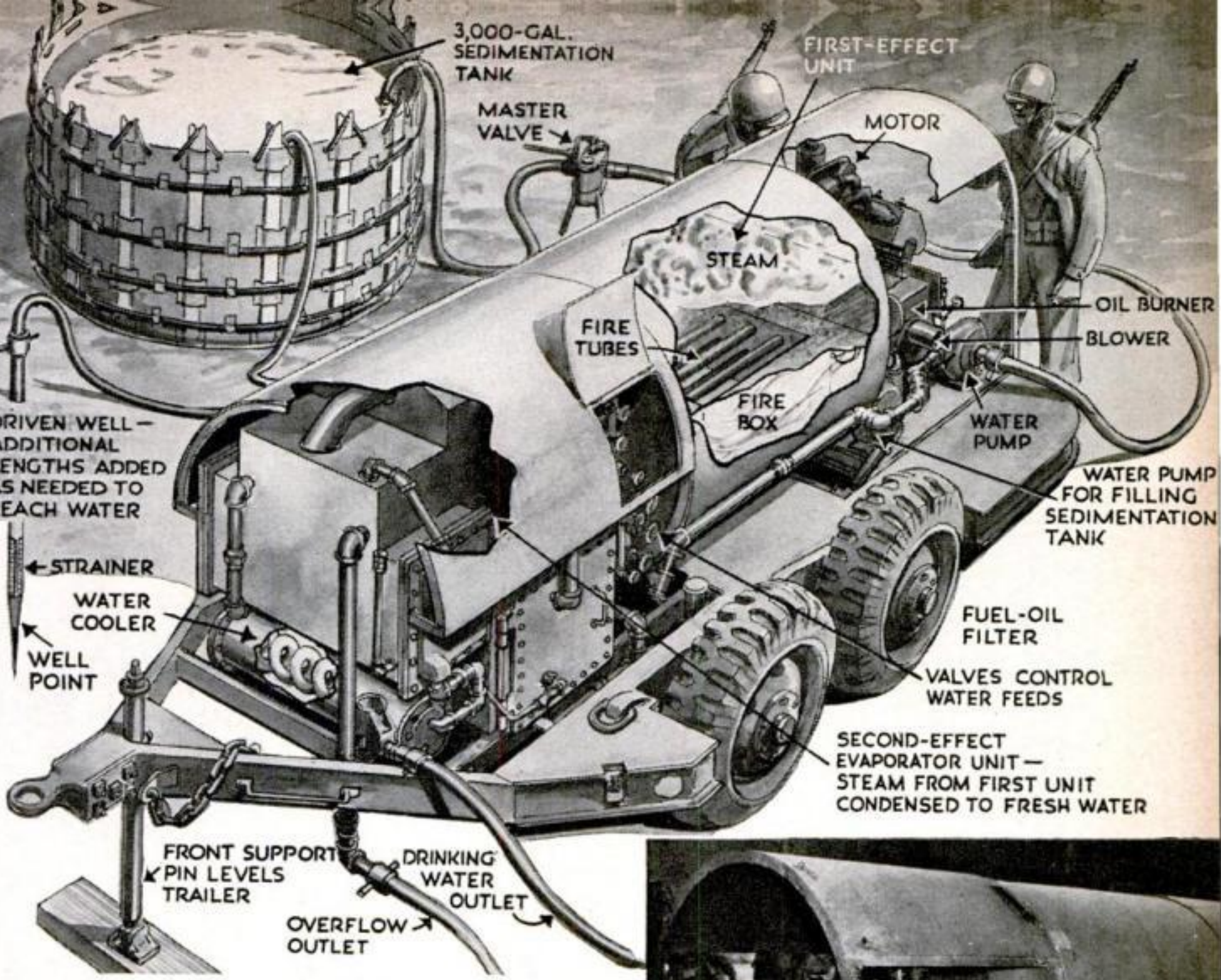
BECAUSE it is impossible, during the ground-testing of a plane, for them to hear each other above the roar of the motors, mechanics at the Santa Monica plant of Douglas Aircraft have devised a hand-sign language expressive enough to put the most eloquent Indian to shame. As in most systems of hand signaling, pantomime is generously employed. Fingers drawn across the eyes indicate that the motor's carburetor mixture is too lean—that the resulting fumes are irritating the mechanic's eyes. If the mixture is too rich, the signal is to hold two fingers as if they were holding a cigarette—to show that the engine is "smoking." A finger drawn across the throat is the sign to "cut" the engine. Pulling the extended forefinger of the right hand away from the clenched left hand shows that a battery cable is to be disconnected. Probably the only one of the 20 or more signs that the uninitiated layman would recognize is the forming of a circle with thumb and forefinger to indicate "O. K."

"CARBURETOR MIXTURE IS TOO LEAN"

"CUT THE ENGINE"

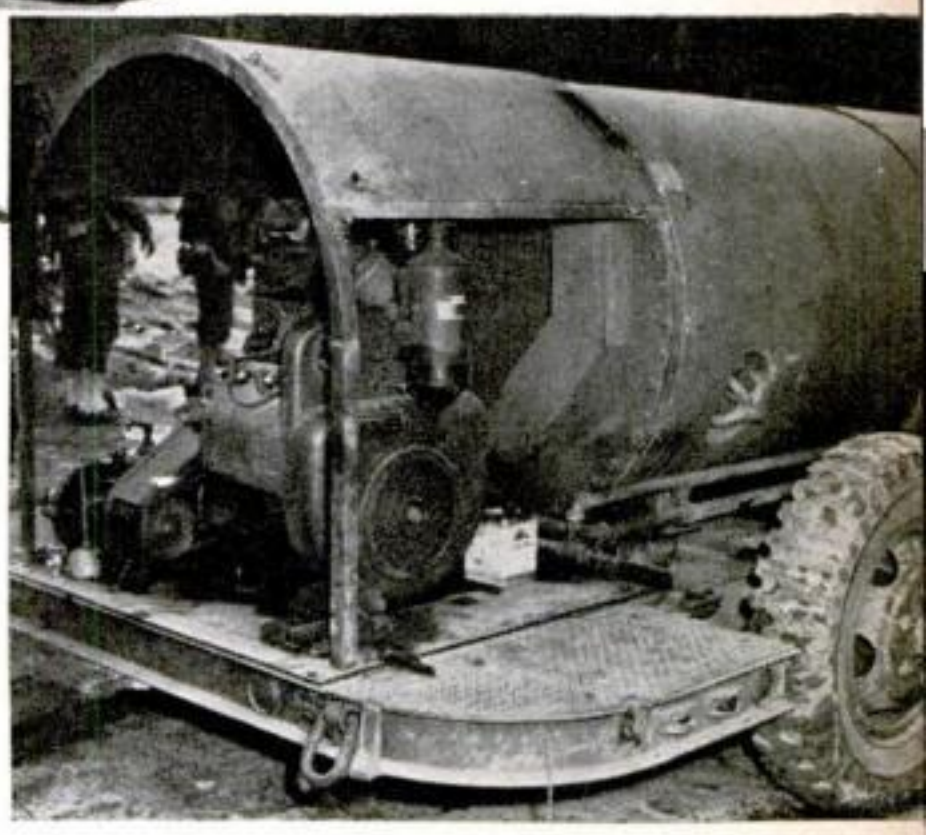
"OIL LEAK – CUT ENGINE"

"ENGINE SMOKING – MIXTURE TOO RICH"



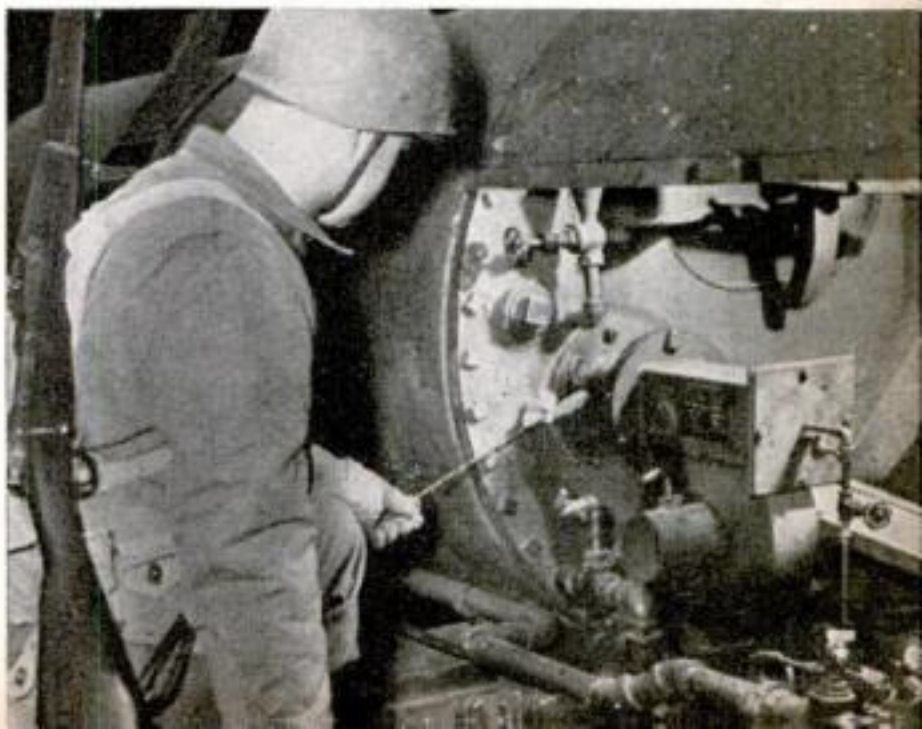
Mobile Beachhead Unit Distills Salt Water

OUR overseas forces now are equipped with a distillation unit that performs the amazing feat of transforming salt water into drinking water at the rate of 100 gallons an hour. Built by the Cleaver-Brooks Company, Milwaukee, Wis., the unit weighs four tons, is highly mobile, and can be landed from a barge. Its prime mover generally is a tractor, but a truck also can be used. Fourteen men and one officer comprise its operation crew. When it is used on a beach, the crew drives a three-inch pipe to water level, instead of pumping directly from the sea. This has a dual purpose: to eliminate trouble from shifting tides, and to tap water from which foreign matter has been removed by seepage through sand. The water is pumped into a 3,000-gallon canvas sedimentation tank before it is pumped into the unit. As the "first-effect" boiler begins to fill, an oil burner underneath is ignited. The resulting steam, generated in about 30 minutes, is carried into a "second-effect" evaporator, and then into a condenser attached to a cooling unit. From here, water at a temperature of about 50 degrees F. begins to flow out for consumption.



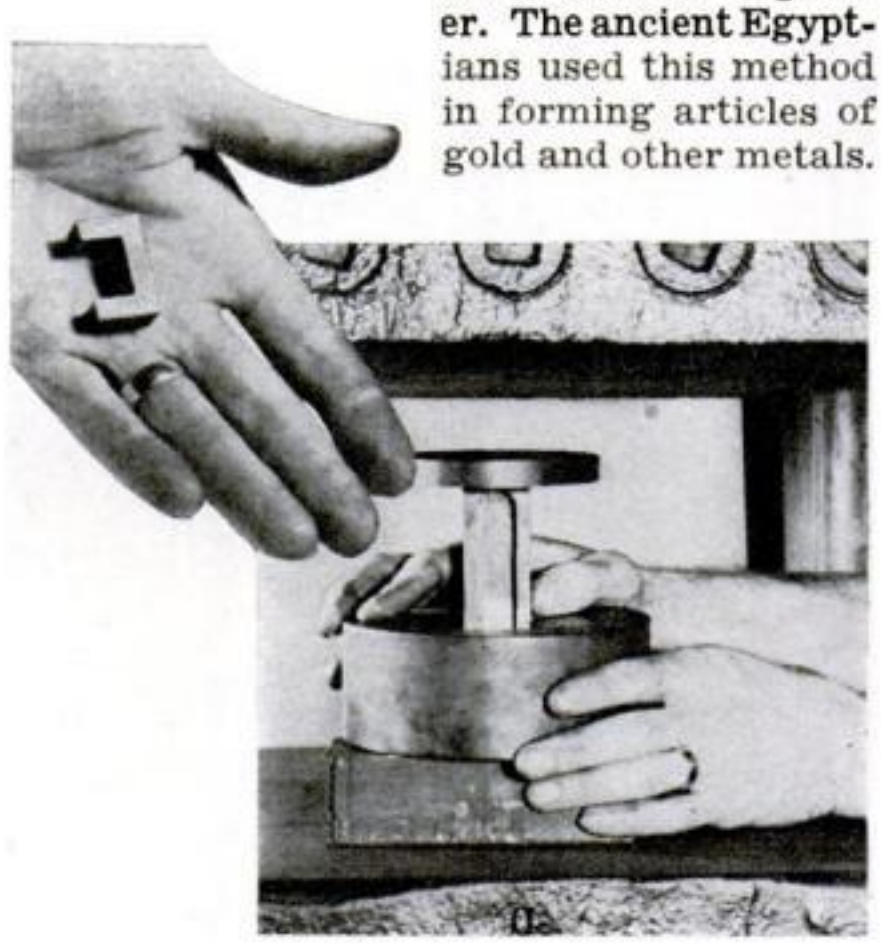
A four-cylinder air-cooled motor pumps salt water into the sedimentation tank, and then into the boiler of the distiller

Lighting the fire tubes that lie under the boiler. Oil is atomized with a blower to mix with the air for greater heat

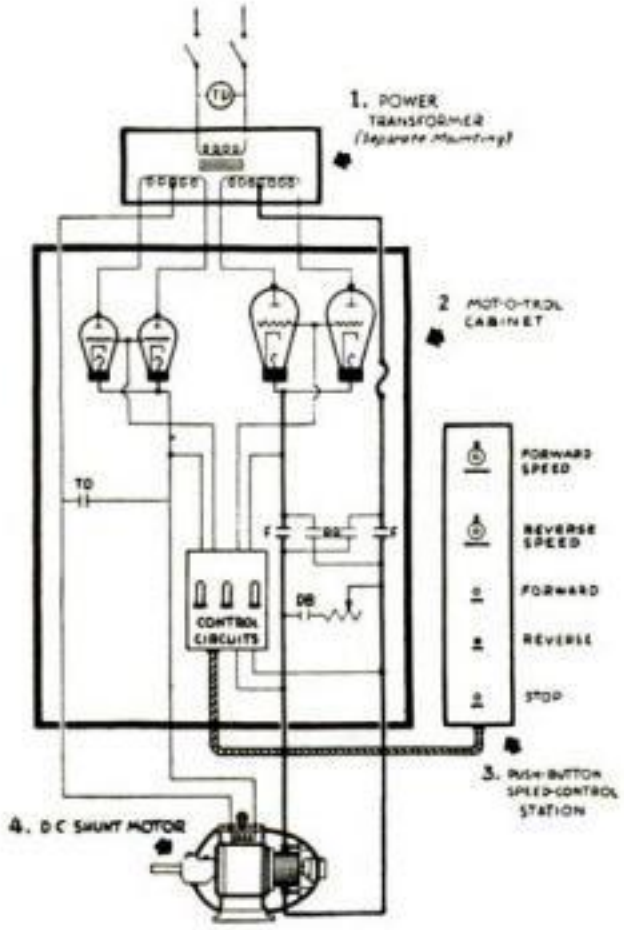


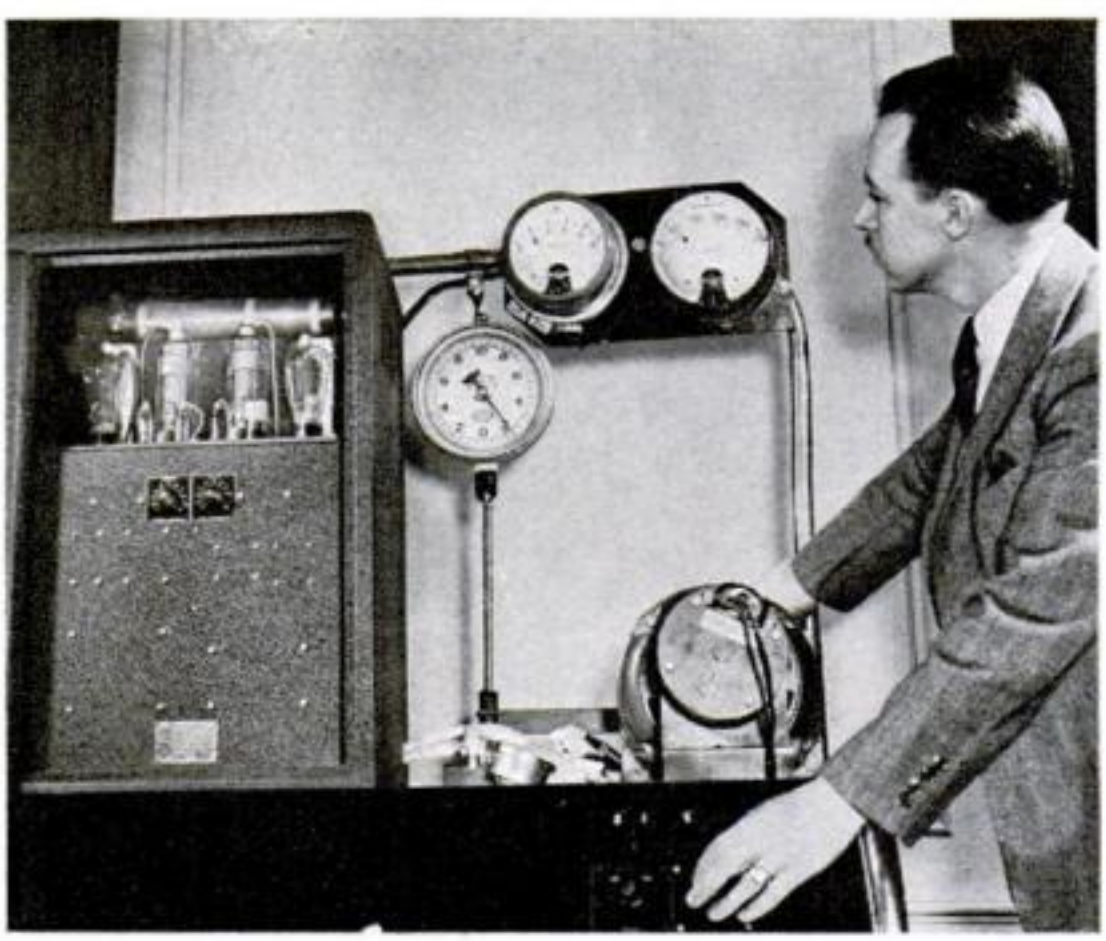
A RADIO SEWING MACHINE, developed experimentally by RCA Laboratories at Princeton, N. J., uses radio-frequency current instead of needle and thread to "stitch" thermoplastic materials into raincoats and caps, weather balloons, and packages for many kinds of foods and oils.

IRON POWDER, almost as soft to the touch as talcum, is being molded by Westinghouse into small magnets for electrical circuit breakers. These, as well as gears, bearings, and other parts, are made simply by pouring powdered metal into a die and forcing the particles into a solid mass by hydraulic pressure. This is then fired at a temperature far below that of melting iron, but high enough to force metal atoms to travel from one particle to another, as it were, knitting the structure together. The ancient Egyptians used this method in forming articles of gold and other metals.

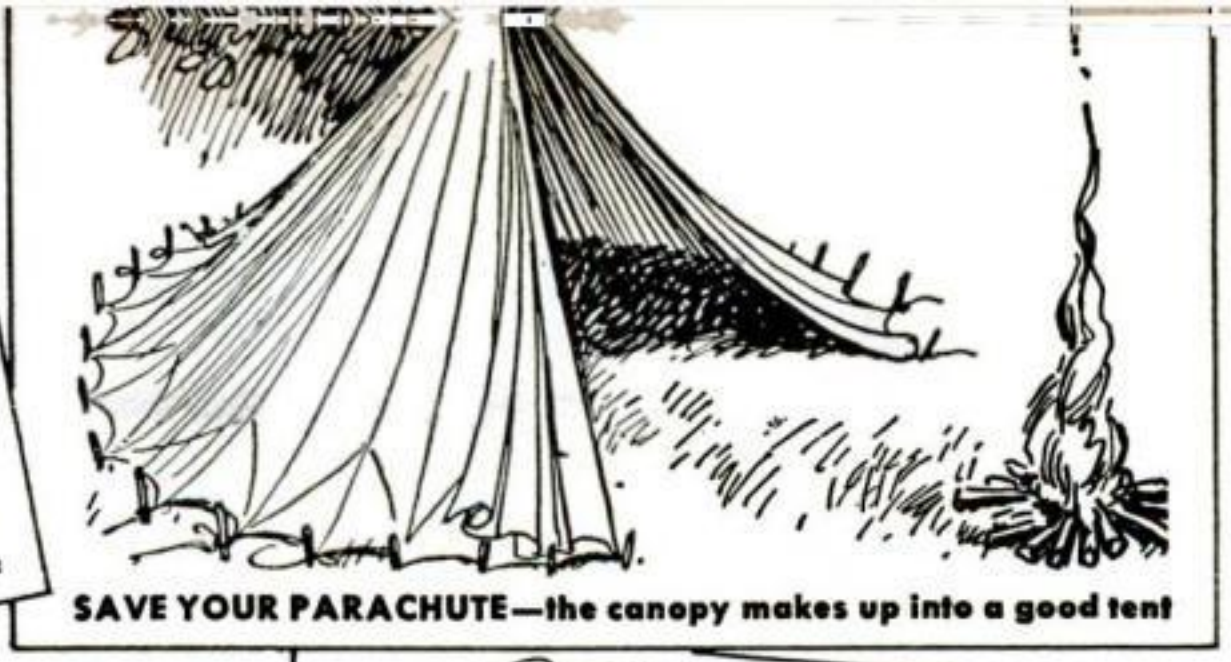


ELECTRONIC ADJUSTABLE-SPEED DRIVE, designed by Westinghouse and called the Moto-trol, provides close regulation over a 20-to-1 speed range for industrial drives on machine tools, winding reels, conveyors, and fabricating and converting machinery. Thyratron tubes, which convert alternating current into direct current, enable direct-current motors to maintain essentially constant speed at any setting, regardless of load. Features include stepless speed control, automatic regulation over wide load fluctuations, full torque at extremely low speeds; smooth, stepless acceleration and deceleration, and dynamic braking.



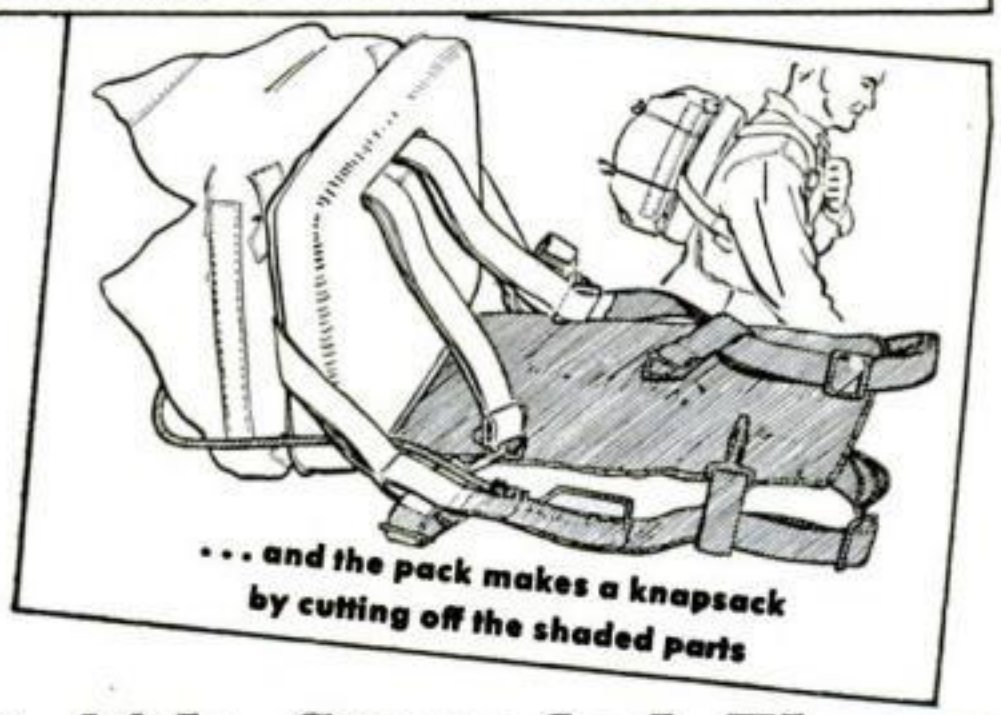


Rain water can be collected by digging hole, lining with 'chute



SAVE YOUR PARACHUTE—the canopy makes up into a good tent

ADVICE FOR FLYERS forced down in jungle or desert is contained in a new guide issued by the U. S. Army Air Forces. Assuring readers that their chances are good if they don't get panicky, the handbook gives practical instructions on shelter, health, and food problems in both kinds of terrain. Designed for aviators, it tells how to make use of a wrecked plane and flying equipment for comfort and safety, as in the drawings above.

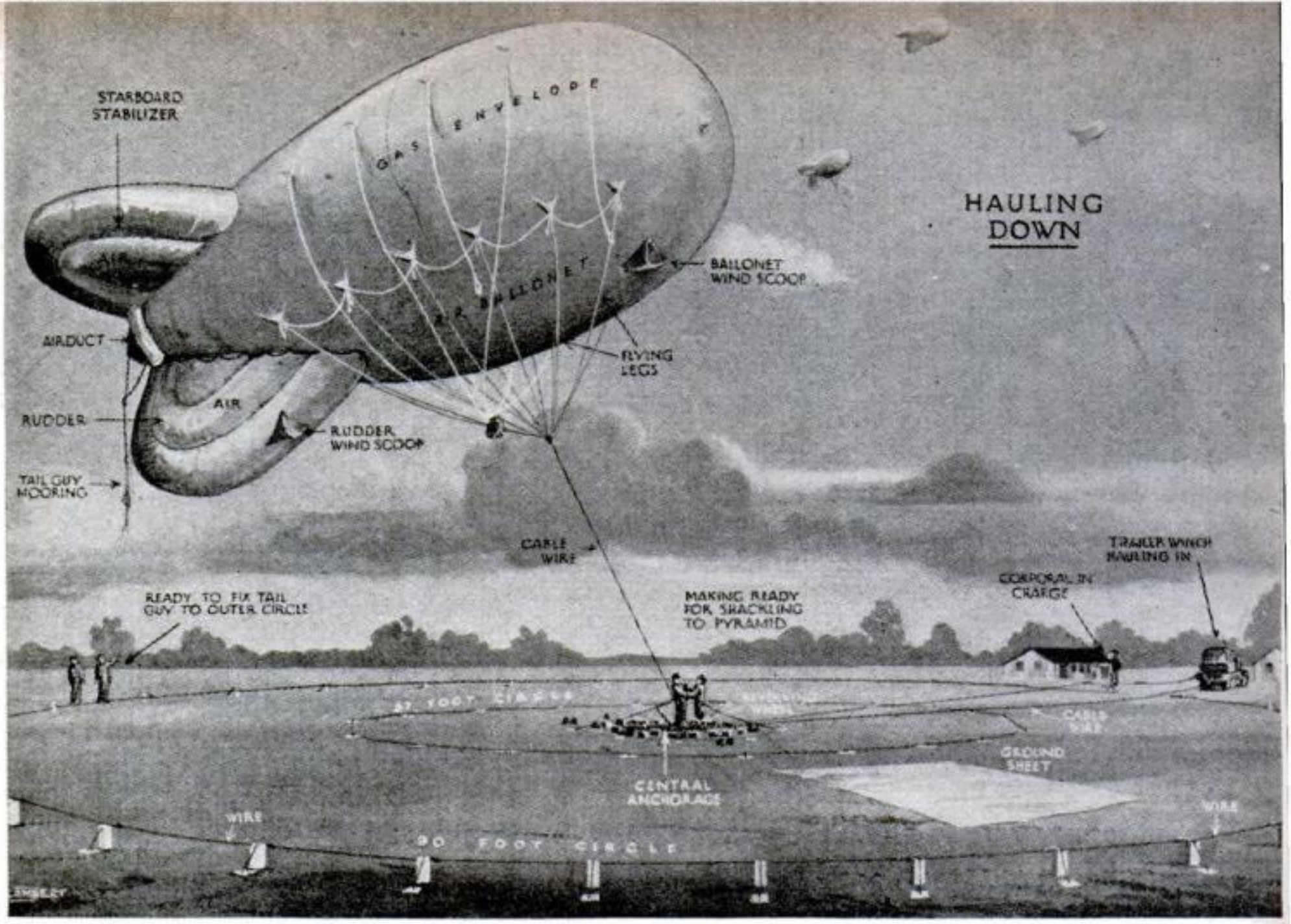


• • • and the pack makes a knapsack by cutting off the shaded parts

Parachute-Pad Kit Aids Stranded Flyers

A JUNGLE KIT designed for emergency landings provides equipment and supplies that will enable a U. S. airman to stay alive until rescued. a machete enables him to hack his way through jungle undergrowth, while fishing tackle helps to feed him. Quinine, matches, and iodine are kept in watertight metal containers. While the iodine may be used on cuts, it is primarily for the purpose of purifying drinking water. Each piece of equipment is fitted into the felt bottom of the kit, and the whole is strapped into the small of the back like the regular back pad used with a pursuit pilot's parachute.

CONTENTS OF BACK PAD BAIL-OUT KIT



British Barrage-Balloon Secrets

HOW THE FAMOUS "SAUSAGES," HANDLED LARGELY BY WAAFS, FIT INTO DEFENSE NETWORK

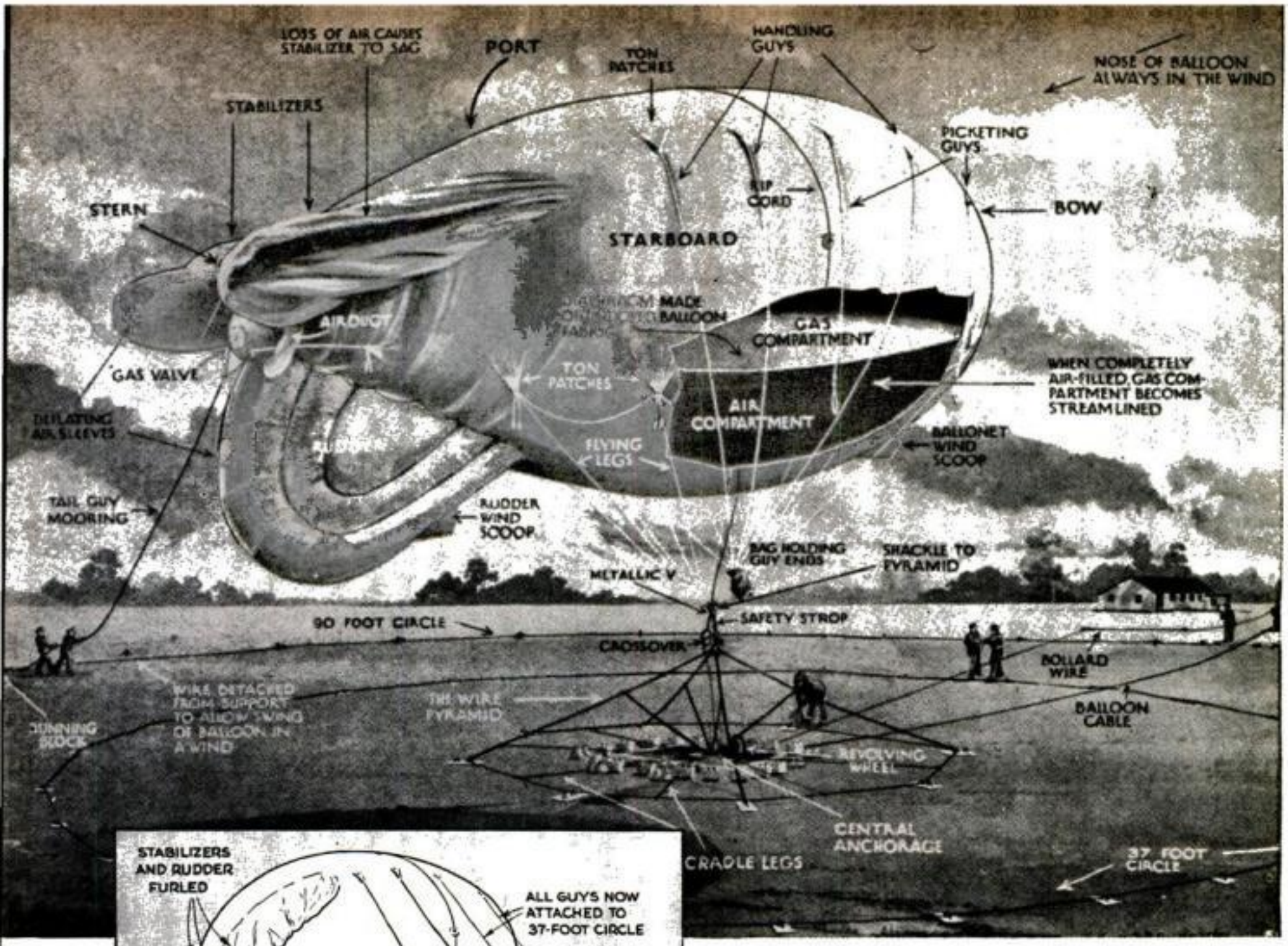
Mooring place of a balloon is a sunken oval in whose center is a pyramid of heavy wire to which the descending balloon is about to be shackled. The trailer winch that winds in the cable is shown in right background

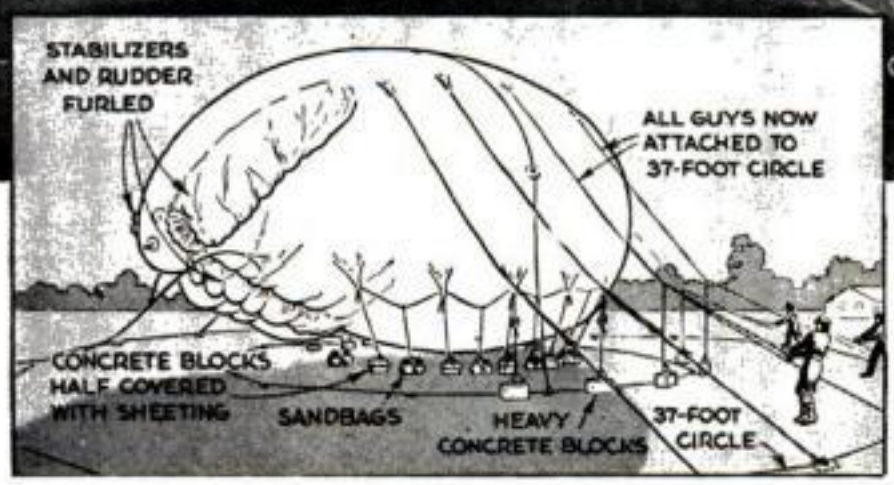
OPERATIONAL details of the famous "floating sausages" that helped England to win the epic Battle of Britain have now been revealed. Integral part of the Fighter Command's close-knit air-raid defense system, barrage balloons enclose critical areas within a fence of steel cables to hamstring low-flying enemy planes. They fall into two categories. One type stays in the air most of the time and is hauled down only for repairs or reinflation, or in case of bad weather. The other is raised only on an "alert," at the same time that fighter planes, searchlights, and antiaircraft batteries spring into action.

Each balloon is filled with 70,000 cubic feet of hydrogen, which gives it a buoyancy of one ton. It is held captive by a steel cable which winds on a winch mounted on a truck-trailer. The Waaf who operates the winch—and many of the personnel of the Balloon Command are members of the Women's Auxiliary Air Force—sits inside a cage. This not only protects her against snapping cables, but it also grounds the lethal charges of static electricity picked up while the balloon is aloft. On signal, the balloons shoot into the air surprisingly fast, and their height and position are frequently changed to alter the pattern of defense.

Nesting place for a balloon is a sunken oval having in the center a collapsible pyramid through which the cable runs from the bag to the winch. The "sausage" is hooked to the pyramid; then its two sets of guys are made fast. The guys are held to the fabric with "ton patches," meaning patches that will stand a strain of one ton.

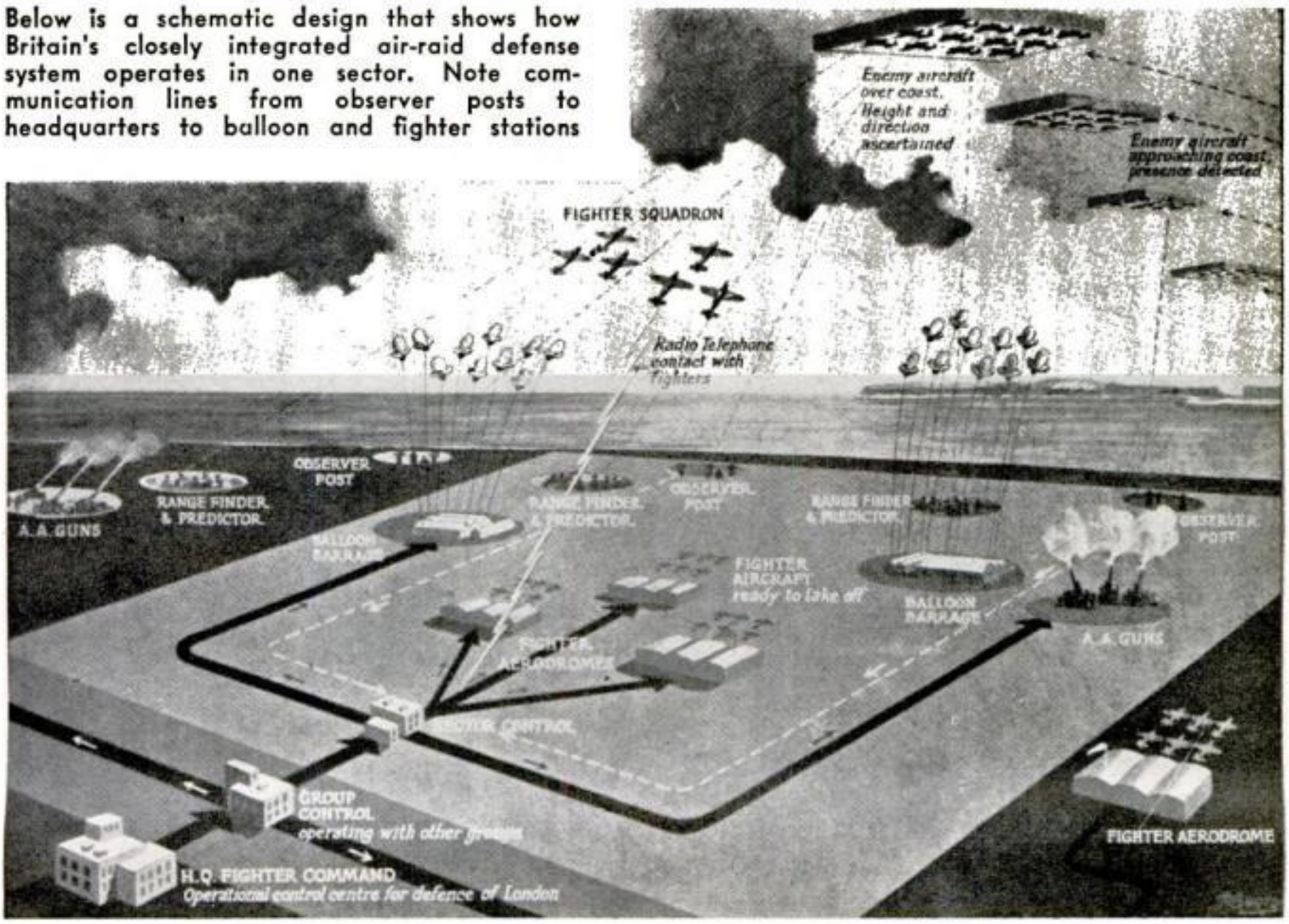
No gas is used in the stabilizers that keep the balloon from rolling over on its back, or in the rudder, which keeps its nose into the wind. Instead, air tubes run along the sides to collect wind for this purpose. As the balloon is hauled down into the region of lower wind velocities, the air leaves the tail and it collapses. The limp fabric is lashed to the body during the bedding-down period, and is unfurled when the balloon is raised. *(Drawings by E. G. Lambert and H. P. Burton from the London "Sphere.")*

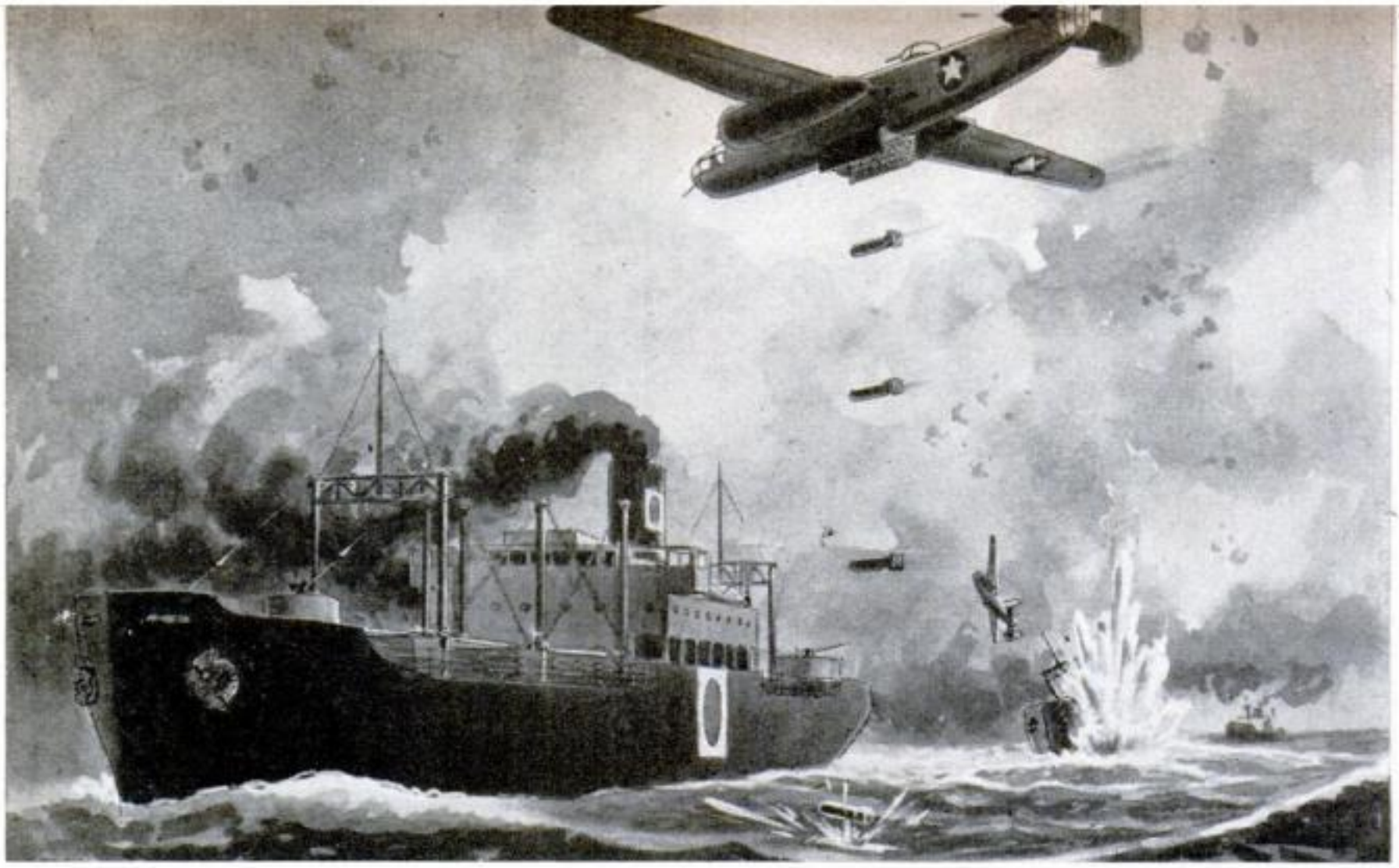




Here the close-hauled balloon has been shackled to the wire pyramid. When the pyramid is made to collapse, the balloon settles into place, as shown at left. Bedding it down is done with guys running from "ton patches" to sandbags, or hooked to heavy concrete blocks and attached to wire in 37-foot circle

Below is a schematic design that shows how Britain's closely integrated air-raid defense system operates in one sector. Note communication lines from observer posts to headquarters to balloon and fighter stations

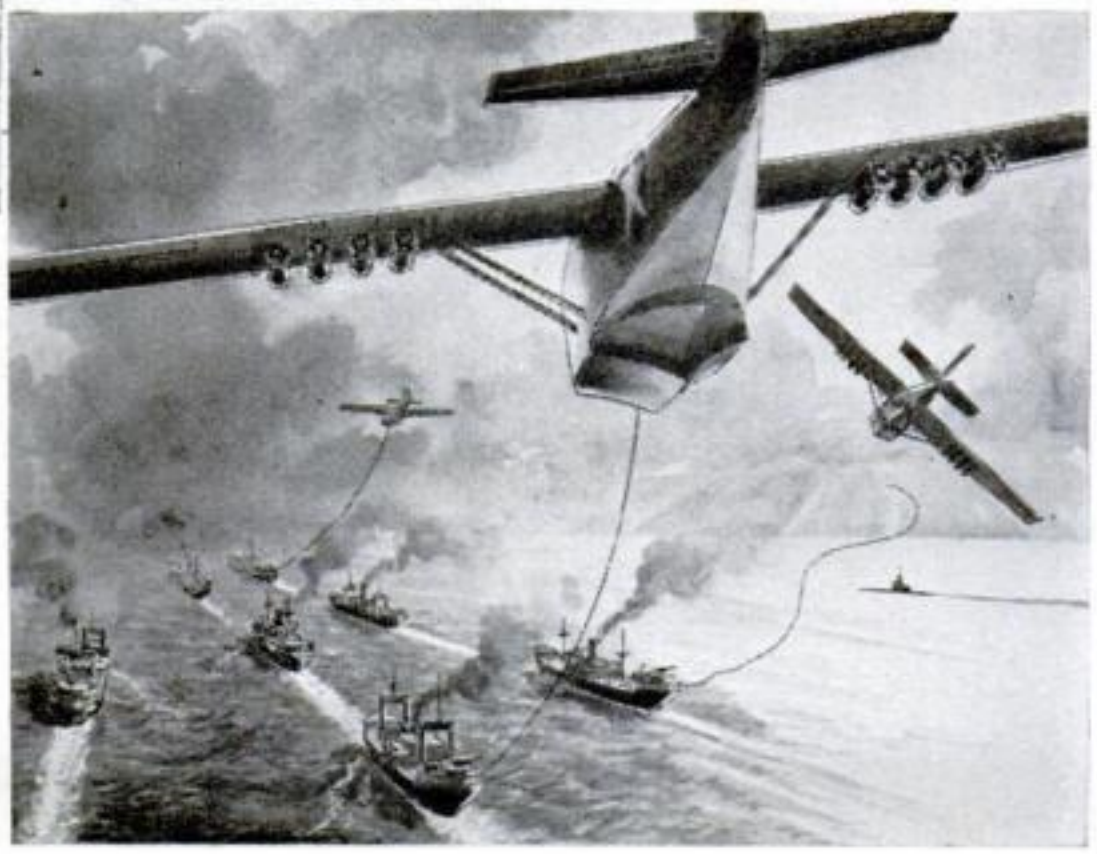




SKIP BOMBING, a new American flying tactic, is taking its toll of Axis ships in the Mediterranean and the Southwest Pacific, where enemy warships and freighters are being sunk from mast height. Dropping bombs from this level is similar to launching torpedoes. They hit the water flat, skip over it like a rock skipped by a boy, find their mark at close range, and complete their deadly mission in just about the time it takes a raiding plane to rise out of danger. When a string of bombs is let loose in this manner, flyers report, they seem to crawl right up the side of an enemy ship.

ESCORT HELICOPTERS are being used by our Navy and Britain to protect convoys in the 500-mile mid-Atlantic gap out of reach of land-based planes. These vertically rising aircraft take off from and land on the decks of freighters. Ability to hover in midair to drop depth charges makes them deadly submarine hunters, and great maneuverability enables them to dodge gunfire.

Drawings by B. G. Seielstad



SHIP-TOWED GLIDERS have been proposed by Col. Edward S. Evans, Detroit industrialist, for protecting convoys from submarines. They would be towed by slow-moving freighters at 1,000 to 2,000 feet, and by fast destroyers and corvettes up to 3,000 feet. Equipment would include 500-pound bombs, machine guns, radios, and powerful searchlights.

Catching Birds with a Paintbrush

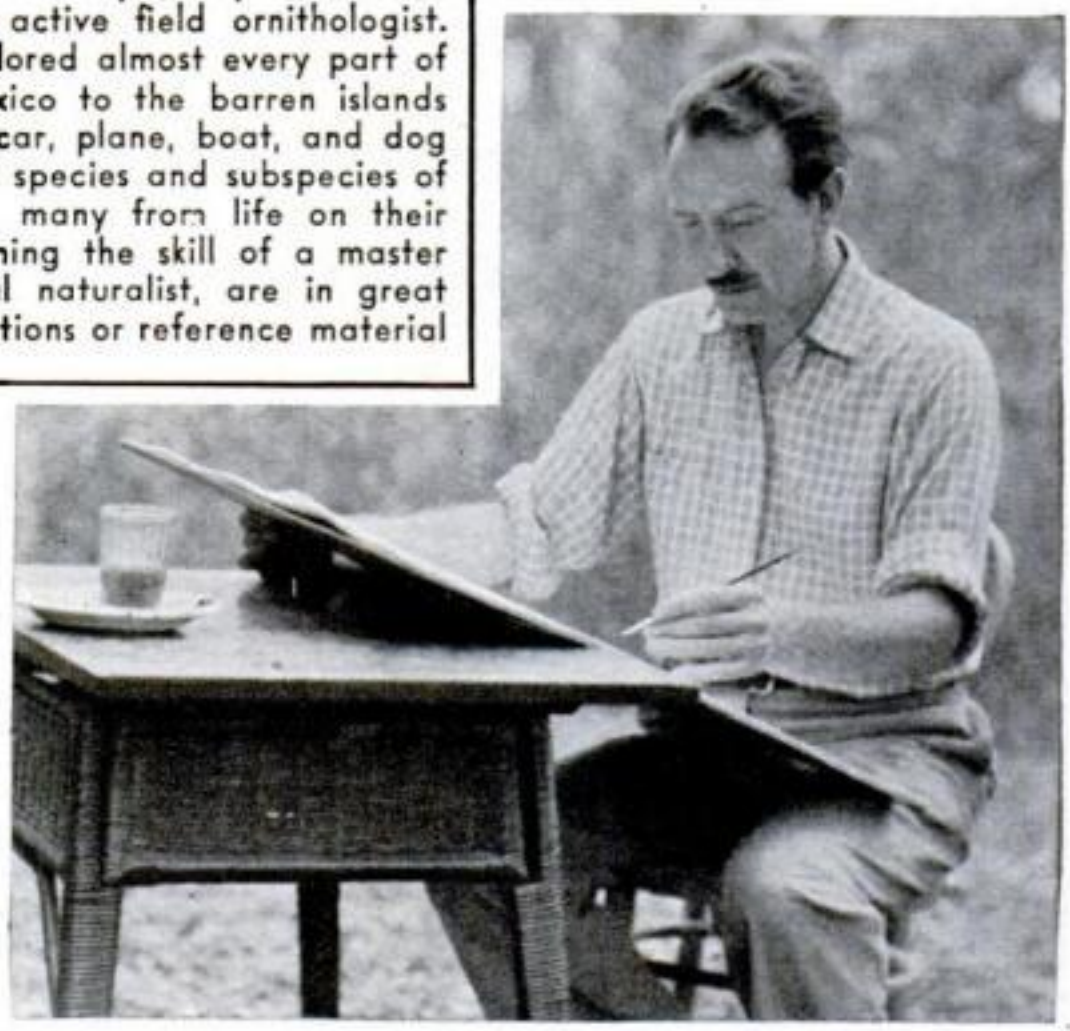
By GEORGE M. SUTTON
(Captain, Air Corps, A.U.S.)

AS FAR back as I can remember, I have been making pictures of birds. Wherever I have gone in my work as an ornithologist — whether to the frozen tundra of Southampton Island, north of Hudson Bay, or to the cloud-hung mountains of Mexico — I have taken my water-color outfit with me. I have seen alive most of the 1,200-odd species and subspecies of birds listed for the vast area lying north of the Rio Grande. Many of these I have been so fortunate as to encounter on their breeding grounds, and to sketch in pencil direct from life or paint in water color from freshly killed specimens. The hundreds of paintings I have brought back amount by this time to a considerable reference library. These paintings are housed at the University of Michigan's fireproof, well-constructed

Courtesy Sporting Gallery and Book Shop, New York

WILD TURKEY GOBBLER. This beautiful painting is an example of the work that has won Captain Sutton top rank among bird painters. It is vibrant with a subtle interplay of colors impossible to show in this two-color reproduction

CAPT. GEORGE MIKSCH SUTTON is not only a top-notch bird painter and nature writer, but also an active field ornithologist. In quest of his subject matter he has explored almost every part of the North American continent, from Mexico to the barren islands north of Hudson Bay, pursuing birds by car, plane, boat, and dog sled. He has seen alive most of the 1,200 species and subspecies of birds found in this vast area, sketching many from life on their breeding grounds. His paintings, combining the skill of a master artist with the knowledge of a practical naturalist, are in great demand by sportsmen and as book illustrations or reference material



Museum of Zoology at Ann Arbor.

I long ago discovered that for quick field sketches of birds I had to have a pencil that would make a rich line, yet not rub off easily, and a white paper strong enough to stand a good deal of erasing and stiff enough not to warp as a result of the warmth and dampness of my hands. After using several varieties of paper, I decided that the best was Strathmore Bond, two-ply for general purposes such as pencil sketches, and three-ply for finished paintings and for especially humid regions. To this day I get my best results from Strathmore three-ply bond if I am doing a water-color portrait direct from life, or a detailed illustration for reproduction in a book. For a brisk water-color intended primarily for decoration, however, I use Whatman's "rough board" or a similar paper.

Before discussing the making of a finished painting—one with complete background and accessory material—I would like to explain the phrase I have just used, "a portrait direct from life." I have read a good many articles, most of them of the Sunday-supplement type, telling of bird artists who have waited half frozen for hours on some mud flat for a chance to draw a flock of brant from life, or braved a blizzard to get an authentic sketch of a snowy owl. This sort of story reads well. But I, for one, am very skeptical. I know all too well how impossible it is for me to turn out any sort of sketch, whether authentic or not, with hands that are wet and cold. In fact, I have to be pretty comfortable all over to turn out anything like good work.

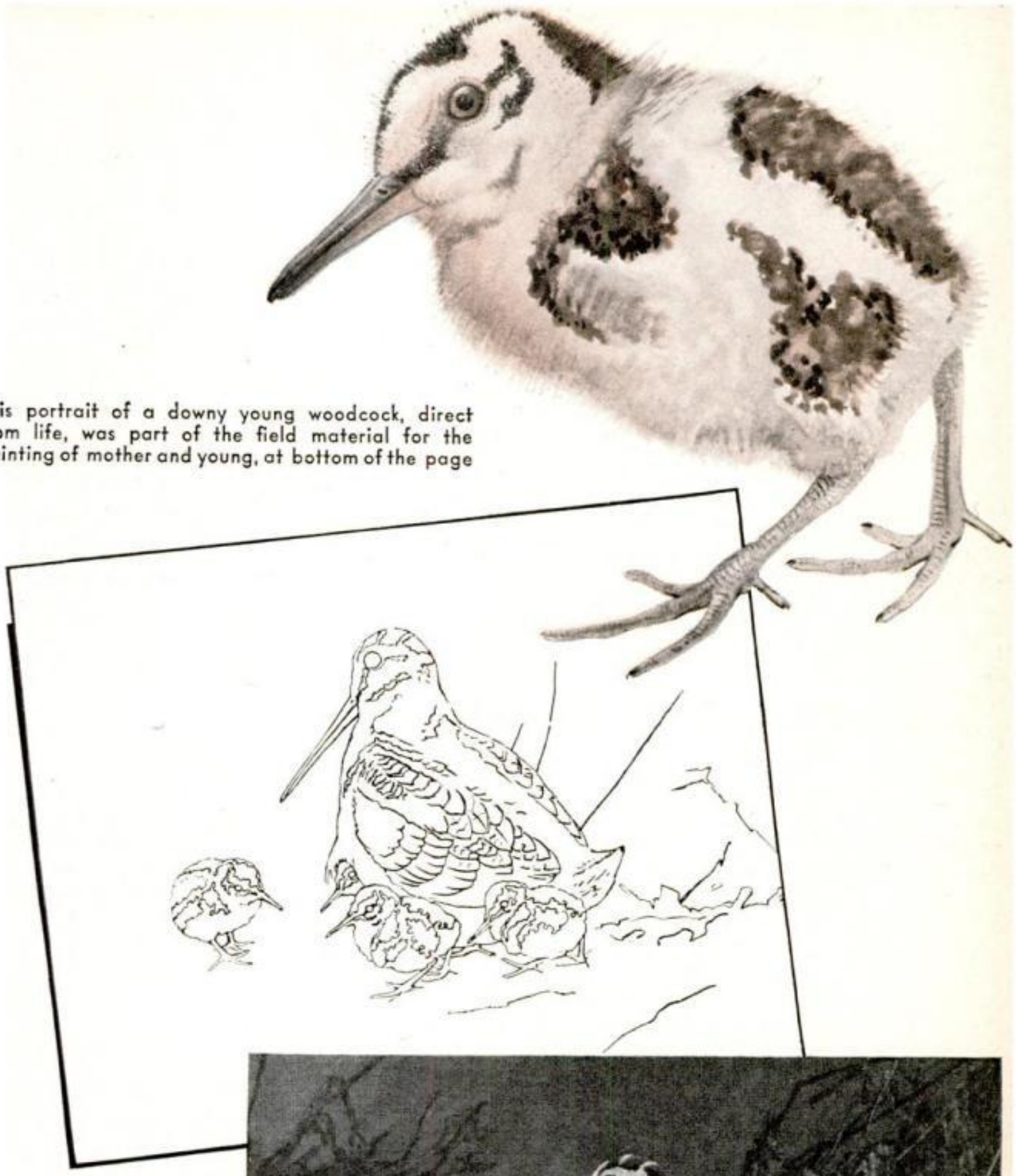
In this article I propose to be as honest as possible, admitting first that I depend on a somewhat photographic memory; that I check drawings with actual photographs whenever possible; that I study and work with birds in zoological gardens whenever I can; and that most of the time I find it quite impossible to make my finished drawings *direct* from living birds. Only occasionally am I fortunate enough to have a bird alive and in good condition at the time I need it. Life sketches, yes. Quick studies showing how a bird holds its wing or how its foot clutches a perch, yes. But a finished painting from start to finish with a living model in front of me, *only rarely*.

The fact is that most living birds in good health make very difficult models. They twitch and squirm, turn their heads, stretch, flutter, chirp, and yawn, repeating attitudes only occasionally and constantly throwing one off the track by doing something entirely new.

A healthy bird in captivity will, however, during the course of an hour or two, repeat various body positions that are completely characteristic of its species; and herein lies the importance of studying a living bird at close range, even though it be impossible to make more than fragmentary pencil sketches of its feet, face, wings, and bill.

Owls make good models because most of them are docile during the day. A barred owl will sit in one position for hours at a time, blinking its big eyes occasionally or turning its head to one side when someone opens a door. It is possible to make an authentic drawing from such a bird, of course, the only fault being that the picture represents the bird not in action but in a sleepy condition.

Some of my best direct-from-life portraits are of ducks caught in winter at live-traps. These models I usually put into old shirt or smock sleeves so their heads will stick out, tie them in so they can't kick and squirm, talk to them and stroke them, and set to work. A good many birds, when treated thus, become quite docile. Others, such as



This portrait of a downy young woodcock, direct from life, was part of the field material for the painting of mother and young, at bottom of the page

Next step was to design the picture in pencil, as above. The grouping was kept simple to permit the color patterns of the birds to be the center of interest. A number of sketches from life were incorporated

The addition of color completes the painting. Again, field sketches and other material were used as a guide. This two-color reproduction fails to give the full effect of the picture

the red-tailed hawk, open their mouths and look fierce, but never bite. Some look the very embodiment of friendliness and harmlessness. Of these beware!

As for the final painting, such as would be reproduced as a book or magazine illustration, I follow two distinctly different methods, depending on the effect I want the picture to achieve. If the bird itself is dark and I want the background to be a simple pale blue, suggestive of a sky, or an indefinite gray-green, suggestive of the woods in spring, I draw the bird and perch in with a hard pencil first, erase everything but these guide lines, then wash in the background color all at once. The paper is now rather wet. It is quite important that before anything further is done to the painting, *the paper must dry completely.* When it is dry, the bird itself may be painted in detail. If, on the other hand, the picture is to have a dark background, I pencil in the details carefully, paint the bird and foreground accessory material first, then mix a quantity of heavy, opaque background color and put this on stroke by stroke with no attempt at general wash, working up to the very edge of the bird, twigs, and leaves with great care.

The woodcock picture reproduced here was of this latter sort. The finished picture was to illustrate primarily the differences between the color pattern of the adult and of the newly hatched young. It was to serve as the frontispiece for Dr. Olin Sewall Pettingill's monograph on this famous American game bird. Since it was to be an illustration of the birds, I could not stress their protective coloration to the point of making them invisible. They had to show!

Before I started the picture, I took from my files all the pencil sketches, water-color field sketches, and photographs I had of the woodcock. I looked up further photographs in certain bird magazines. Dr. Pettingill, who had been making exhaustive studies of the bird, sent me his photographs. Among all this material were a life portrait of the head of an adult bird and two portraits of downy young direct from life.

Designing the picture was simple, for I did not have to show both the male and female parents, and grouping the newly hatched young around the mother was a natural thing to do. For a time I was tempted to hide all five of the birds behind a certain amount of dead weed stalks, leaves, and briars; but I decided it was best to keep the whole thing simpler, thus permitting the color pattern of the birds to be the center of interest.

When the drawing in pencil was finished, I began painting. At hand were all my sketches of freshly killed birds, all the photographs which would give me a check on high lights, several skins of woodcock in adult and downy-young plumage, and a bird that I had had mounted with drooping wings so as to make it possible for me to work out the perspective of the cross-barring accurately. This specimen I took outdoors several times, so as to observe what happened to the colors as they were affected by different lights. I was obliged to paint slowly, almost laboriously, for the patterns of an adult woodcock's upper parts are exceedingly intricate. By the time the birds were done they looked rather like cut-outs lying on perfectly white paper, for the background had not yet been touched.

The background color was a mixture of show-card white, Windsor & Newton lamp black, Windsor & Newton Payne's gray, and Schmicke tube brown. I name these to show that I often mix different sorts of paints according to the effect I wisn to produce. When I had a dinner plate covered with this thick paint to a depth of about a quarter of an inch, I mixed it thoroughly, tipped my brushes carefully, and began painting the background. After I had established the tone in the upper half of the picture, I added more brown and some other colors to give variety to the tones of the lower half. Until the paint was quite dry the picture looked pretty blotchy; in fact, it looked spoiled. But when it dried, the background tones became very smooth and pleasing, and they set off admirably the minute detail of the birds and the filigree of dead twigs and weed stalks.

Sometimes I cut birds out of paper and arrange them on the sheet. This method may be especially valuable when one is doing a flock of flying ducks, or four or five cedar waxwings, all of them at the same distance from the eye. But I don't often do this. Instead I draw very lightly, erase, and redraw until I can see that the picture is going to carry across my idea.

These last two words are important. An *idea* is, after all, what the artist is trying to set down. He is not trying to re-create a bird. He knows he is limited to two dimensions. He is creating an optical illusion—the illusion of what he himself sees and feels about a bird; he is interested not so much in the bird's local colors and color-patterns as he is in the way sunlight, direct or filtered, or reflected, affects these *for him.* He knows that certain strokes will best reproduce what he sees. By the time he knows his own powers thoroughly he will best let one stroke do the work of ten, because he knows that the illusion of a living, moving bird may most perfectly be created by brush strokes that have, themselves, a certain brisk life and movement.

SURER FOOTING for planes landing on sand or soggy fields is provided by new high-walled, channel-tread tires, made by Goodyear. Projecting sidewalls compress the soft landing surface between them, thus offering the tread more grip and greater "flotation," or ground contact. The tires also permit the plane to carry extra-heavy loads.

MULTIZIPPER COVERALLS, designed by a Canadian garment company, allow emergency operations to be performed in the field while reducing the danger of shock to patients from exposure to the cold. Slide fasteners, opening at either end, run from neck to toe, neck to fingertip, and neck to forehead. Thus the injured part can be uncovered and treated while the rest of the body is kept warm.

WATERPROOF PACKAGING is enabling boxes and cartons of war supplies to stand in the rain or snow for long periods, or even to be thrown overboard in beachhead landings and floated to shore, without water damage to their contents. Containers that can stand a 24-hour immersion in ocean surf (inset, right) are being manufactured by the Robert Gair Company, of New York. The "Aqua-Proof Pack," of the Loose-Wiles Biscuit Co., of New York, has been found to keep ration biscuits dry after a 12-day immersion in a tank of water. Intended as a substitute for war-needed tin, these new types of packaging, besides being lighter, have actually proved more water-resistant than the metal containers they are replacing.

Below, Army-ration biscuits keep dry in "Aqua-Proof Pack" of the Loose-Wiles Co.

What Are the Facts About the RADAR?

FOR YEARS A CLOSE MILITARY SECRET, THE DEVELOPMENT OF THE MAGIC EYE THAT SPOTS ENEMY PLANES IS NOW REVEALED AS A MAJOR TECHNICAL VICTORY FOR THE UNITED NATIONS

TELESCOPE the phrase "radio detection and ranging" into "radar"—and you have a word that, until recently, was taboo even to mention. It's the American name for one of the few basically new weapons of this war, developed independently in this country and abroad. Now a joint Army-Navy announcement has ended the total blackout surrounding our version of the hush-hush weapon.

Through fog, storm, or darkness, radar spots enemy planes and surface ships, for defense and attack. One of the marvels made possible by the electron tube, it emits radio waves of ultrahigh frequency. Reflected from a hostile craft, these waves bounce back to the radar station. Although they travel at the speed of light, 186,000 miles a second, the extremely short time between their start and return can be measured accurately. This interval reveals the distance of approaching air raiders, or the range of a naval target. Radar instruments are compact enough to be installed in airplanes, as well as on land and aboard ships.

The British declare that their similar instrument, which they call the "radio locator" (P.S.M., Oct. '41, p. 82), helped save England during the aerial blitz of 1940-1941. It warned of distant air raiders in time for defending planes and antiaircraft guns to give them a hot reception. Losses of German planes became so heavy that wholesale bombing had to be called off.

At sea, radar may prove the weapon needed to end the U-boat menace. A submarine cannot travel submerged for long, but must surface to recharge its batteries. Preferably it does so at night, when darkness protects it from observation. But the magic "eye" of the radar easily spots it. Equipped with this apparatus, a convoy escort ship can pump shells into a sub before it has a chance to dive. This offsets the increased strength of modern submarine hulls, which are said to withstand the underwater explosion of a depth charge at a fraction of the distance that formerly disabled or destroyed them.

A superdreadnought equipped with radar, as ours are, can locate an unseen enemy battleship and drop a broadside upon it. Radar operates to a distance as great as the range of the biggest guns. The deadly accuracy with which they are aimed with the aid of data provided by radar might supplement, if not actually replace, the use of spotting planes.

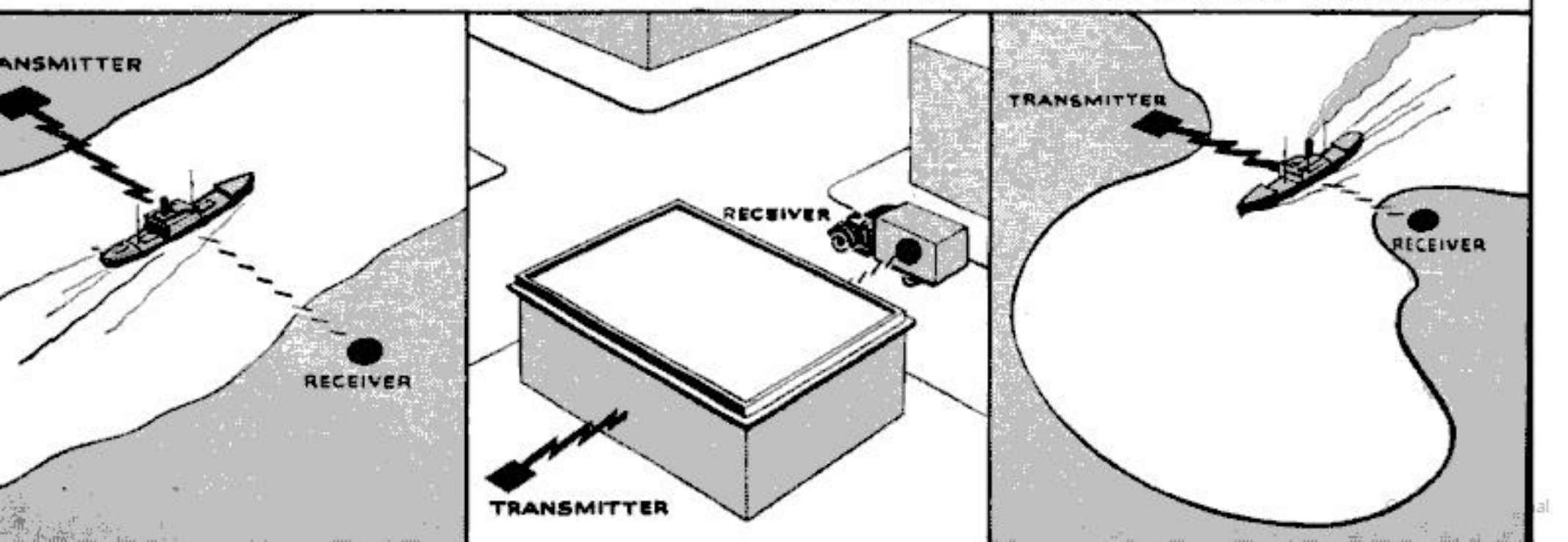
Hostile fleets provided with radar will not meet by accident—as actually happened in

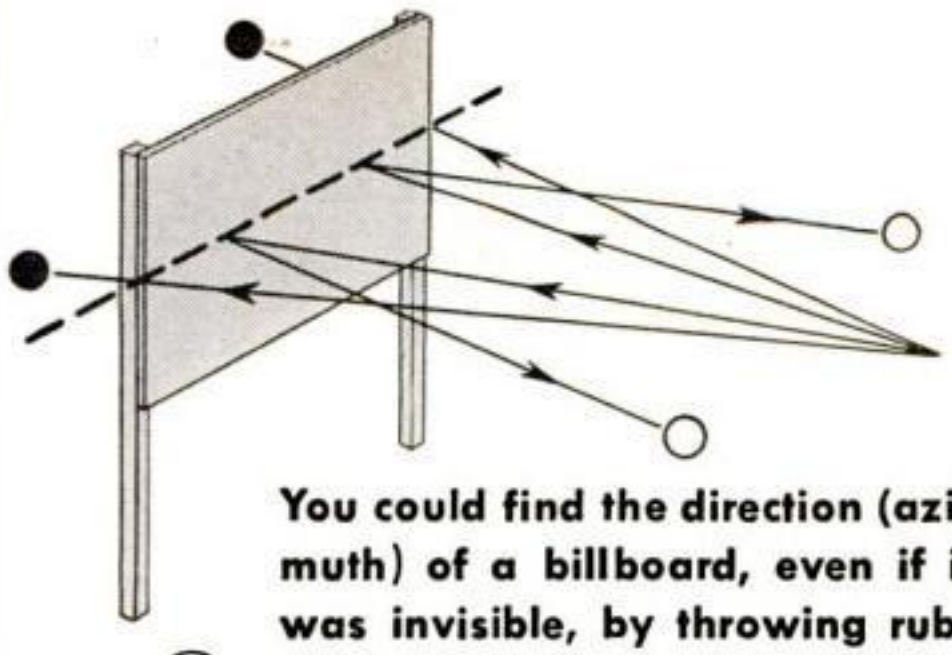
BIRTH OF A POWERFUL NEW WAR WEAPON

As early as 1922, American scientists discovered that objects crossing the path of radio signals interfered with reception, as in the test illustrated below

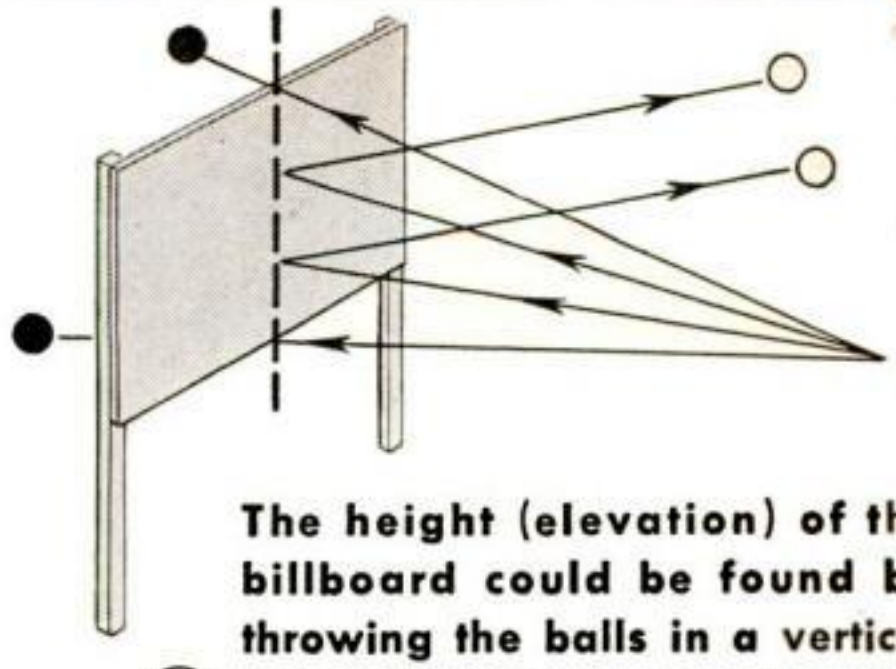
Similar effects were observed when a receiver mounted on a truck was driven past large buildings in such a way that they came between the receiver and the transmitter sending signals

A military application that suggested itself was for guarding entrances to harbors. Waves sent between transmitter and receiver on opposite shores would detect passing of enemy ships

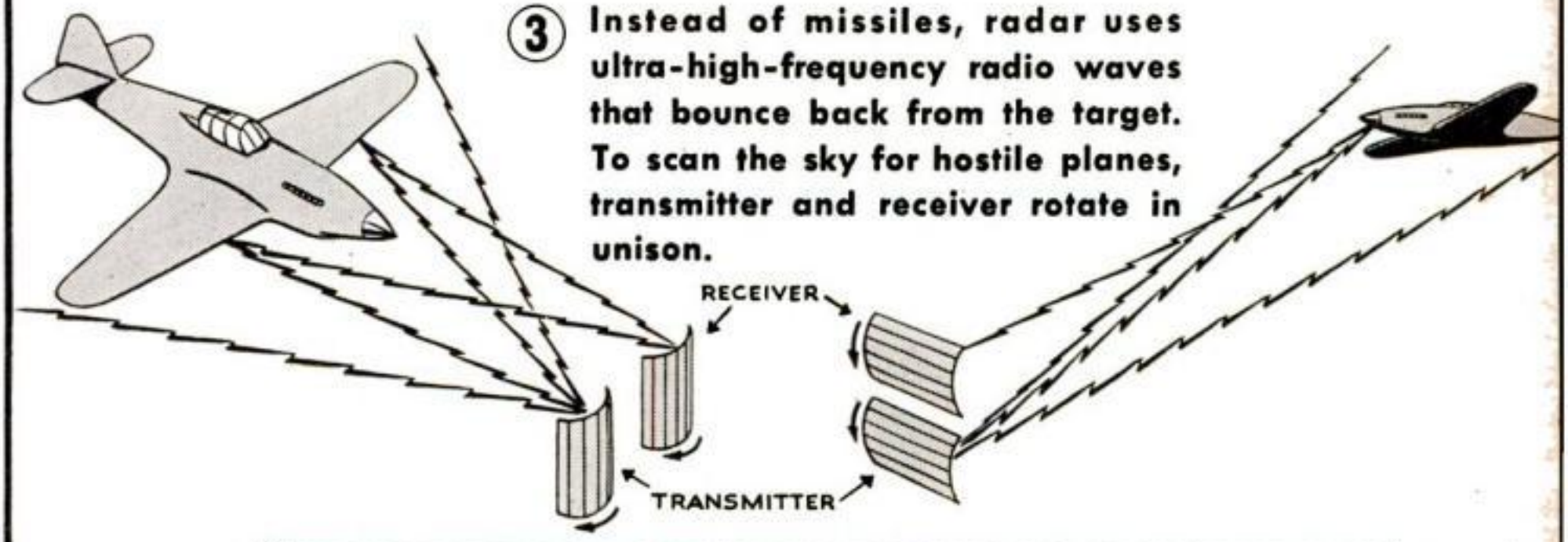




① You could find the direction (azimuth) of a billboard, even if it was invisible, by throwing rubber balls along a horizontal line and noting which bounced back.



② The height (elevation) of the billboard could be found by throwing the balls in a vertical line until they went over the top instead of returning.



③ Instead of missiles, radar uses ultra-high-frequency radio waves that bounce back from the target. To scan the sky for hostile planes, transmitter and receiver rotate in unison.

④ Radio waves are invisible. Therefore, the original Lyman patent proposed that they be used to train the beam of a cathode-ray tube on a marked screen.

...HOW AMERICAN RADAR WAS DEVELOPED

Similarly, they would spot ships passing between other vessels at sea. The usefulness of this device was limited by the necessity of having instruments on the opposite sides of the target

A big step forward came in 1926, when it was found that surfaces would reflect high-frequency radio waves. Transmitter and receiver could now be kept together

All that remained was to measure the distance between radar and plane. This was first done in 1934 by clocking the round trip of waves to plane and back

A dramatic victory for radar was the sinking of a Japanese vessel by an American warship which detected its presence in the dead of night at 20,000 to 30,000 yards. One salvo destroyed it

WHAT RADAR DOES

In antiaircraft defense, it detects the approach of raiding planes at great distances and insures accurate night fire

Installed in fighter planes, it enables pilots to "see" raiders in darkness or fog, frustrating "blind" bomber attacks

It is helping lick the U-boats by spotting submarines when they surface to recharge their batteries, usually at night

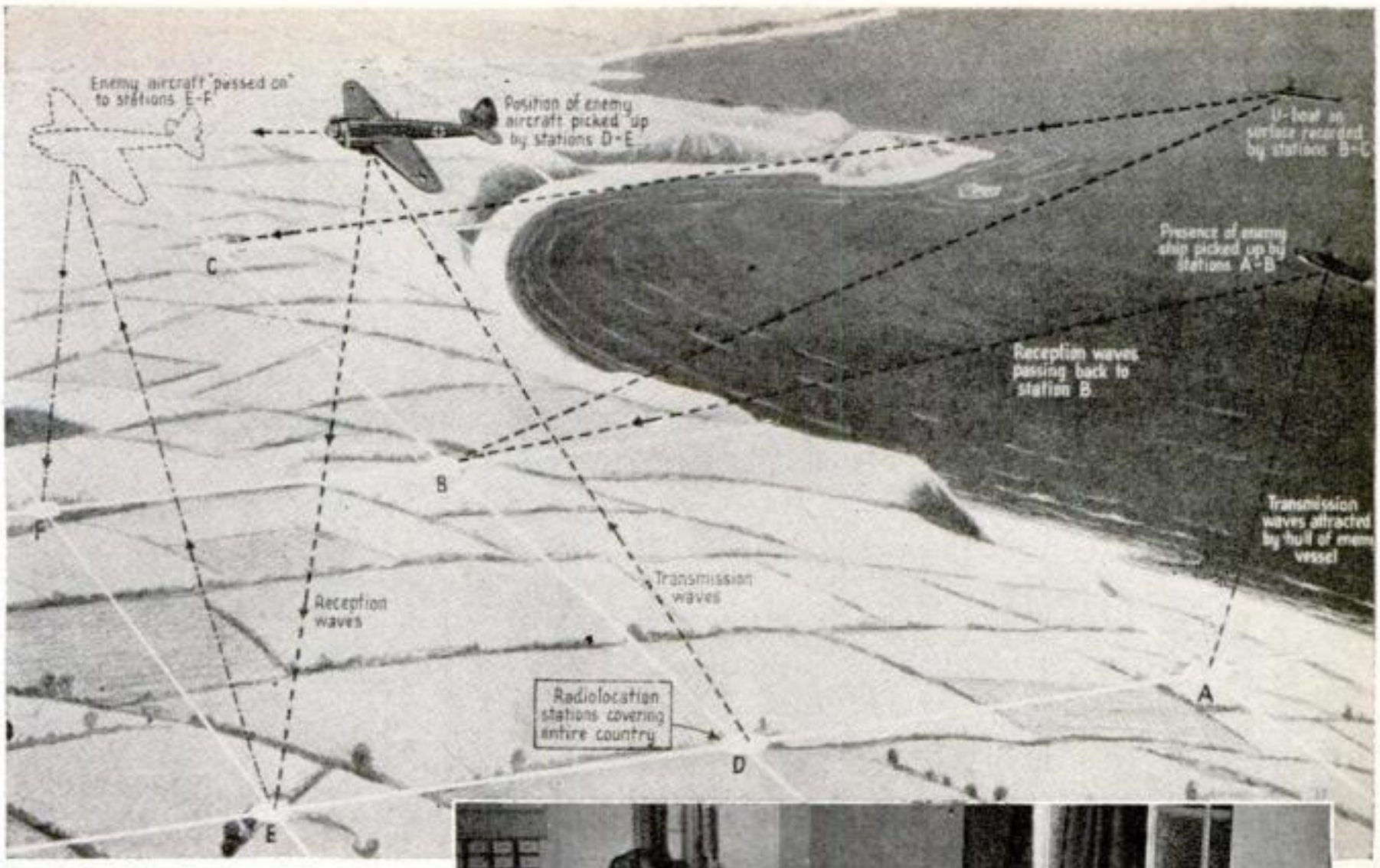
the historic Battle of Jutland. Knowing the enemy's presence, they may choose whether to seek or avoid action.

After the war, radar promises new wonders. Ships plying dangerous passages will steer clear of rocks and reefs by radio echoes, and collisions in fog will be a thing of the past. Airliners, followed from ground stations by radar, will be warned by radio when they are off course. But, right now, the scientific marvel has more pressing tasks.

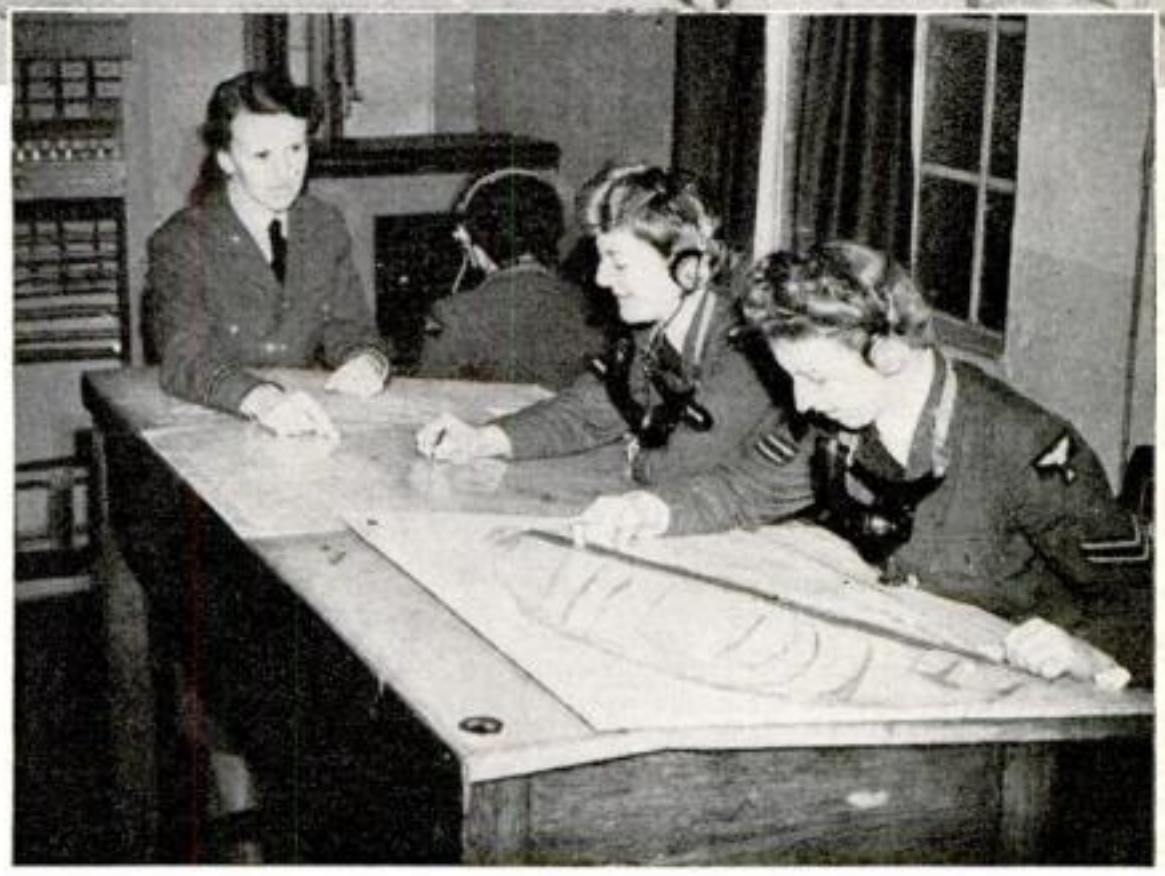
Who invented radar first? Both this country and Britain have a good case, with Germany—reported to have an inferior type—a late comer. The British appear to have started first, while Americans seem to have obtained practical results sooner.

A Scotch weather man, Robert A. Watson-Watt, obtained a British patent as long ago as 1919 upon a device "useful for meteorological purposes such as the location of atmospheric electrical discharges." By doing this, he hoped to improve radio transmission. More than a dozen patents subsequently issued to him dealt with direction finding for ships and planes. The final result was the British radio locator. In 1935, Watson-Watt demonstrated the ability of his first experimental model to trace the course of a plane maneuvering overhead and out of sight, near Daventry, England.

How American radar was developed is



L. A. Wood in London Sphere



How radio locators, British version of radar, detect enemy air and surface craft. At the right, Waafs plot air raiders' location

revealed for the first time in the Army-Navy official report, and in a subsequent Navy announcement. In 1922, American scientists discovered that an object moving in the path of radio signals interfered with reception. Setting up a receiver on a river bank, they studied disturbances caused by passing boats. On land, they observed similar effects on radio signals when a receiver in a truck was driven past large buildings. Couldn't the same principle be applied for the military purposes of detecting a ship entering a harbor, or passing between two other vessels at sea? Tests gave an affirmative answer. But the necessity of having the transmitter and the receiver on opposite sides of the "target" limited the usefulness of the device.

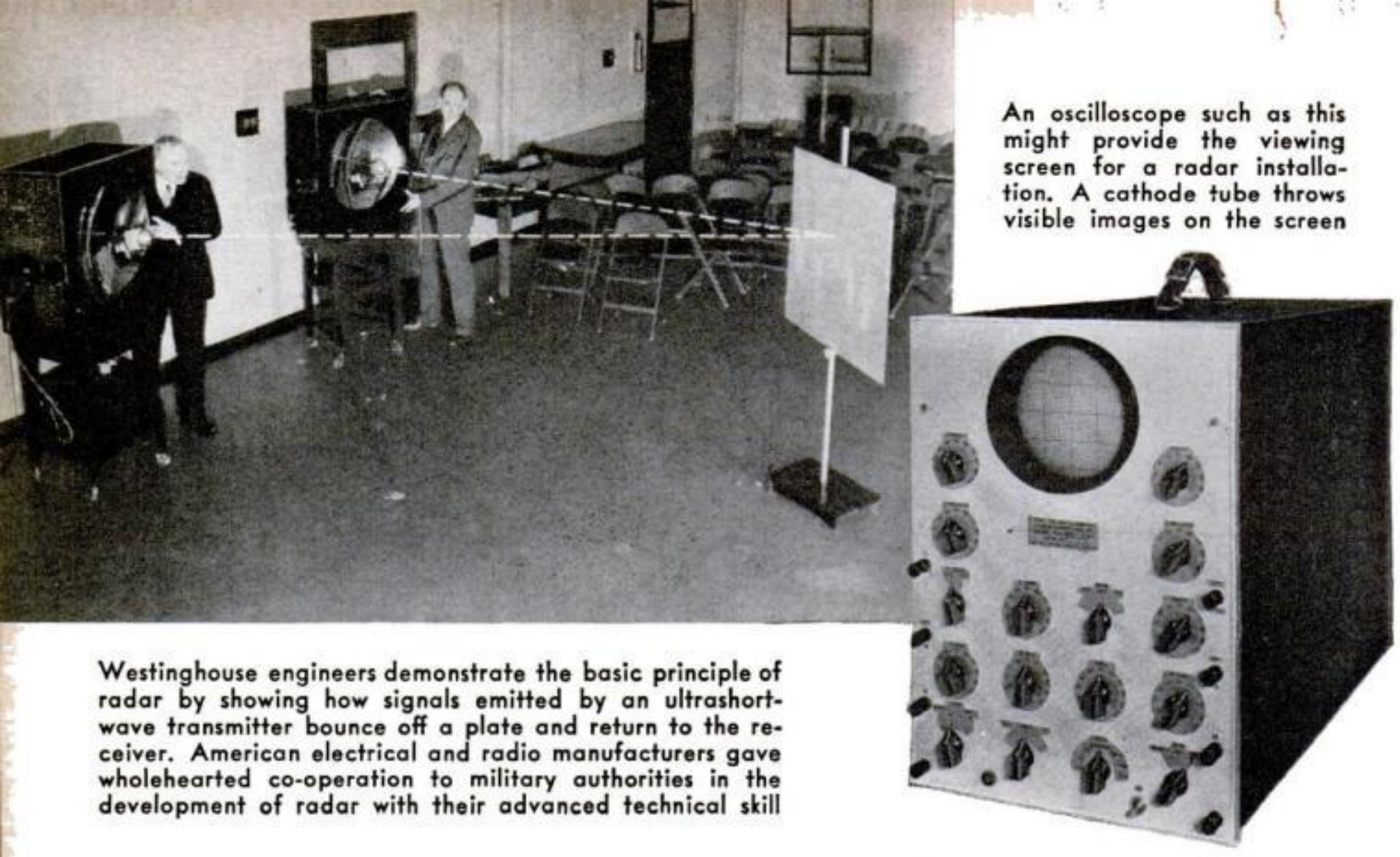
Then, in 1926, came the further discovery that the surface of an object would reflect radio waves of high frequency Since the waves returned to their source, the transmitter and receiver could be installed at the same place—and our first radar was born. Research men worked upon it until, in 1930, they were able to pick up radio "echoes" from planes passing overhead. The theory of reflection from moving objects was confirmed by experiments conducted in cooperation with the dirigible *Akron*.

In January 1931, the U. S. Naval Research Laboratory was assigned the following task:

"INVESTIGATE USE OF RADIO TO DETECT THE PRESENCE OF ENEMY VESSELS AND AIRCRAFT. SPECIAL EMPHASIS IS PLACED ON THE CONFIDENTIAL NATURE OF THIS PROBLEM."

By this time airplanes in motion nearly 50 miles from the transmitter had been detected under certain conditions. It remained to measure the distance from the radar to the plane, a feat accomplished by 1934.

Late in 1938, the first practical shipboard radar was installed upon the U. S. battleship *New York* and given three months of intensive trials at sea. Vice Admiral Alfred



An oscilloscope such as this might provide the viewing screen for a radar installation. A cathode tube throws visible images on the screen

Westinghouse engineers demonstrate the basic principle of radar by showing how signals emitted by an ultrashort-wave transmitter bounce off a plate and return to the receiver. American electrical and radio manufacturers gave wholehearted co-operation to military authorities in the development of radar with their advanced technical skill

Johnson, commanding the Battleship Division, stated, "The equipment is one of the most important radio developments since the advent of radio itself." No less enthusiastic are the comments of Army men. Brig. Gen. Dale D. Hinman, for one, cannot believe that luck did not play a part when artillery aided by radar data brought down practice targets with as few as 14 rounds of ammunition.

Pioneers of radar development now are revealed to have included Maj. Gen. Roger B. Colton, U. S. Army; Commander A. H. Taylor, U. S. Navy; and Dr. John H. Dellinger, of the National Bureau of Standards. Honors must be shared by the country's leading electric and radio manufacturers, who co-operated wholeheartedly in perfecting radar and getting it into mass production.

Following the interest aroused by the Army and Navy reports, makers of U. S. radar have made public additional details with Government approval. At the post of the observer, according to the Western Electric Company, a cathode tube acts as an interpreter and makes reflected signals visible to the human eye. These signals give all the information necessary for plotting the distance, the elevation, and the azimuth, or horizontal direction, of a plane.

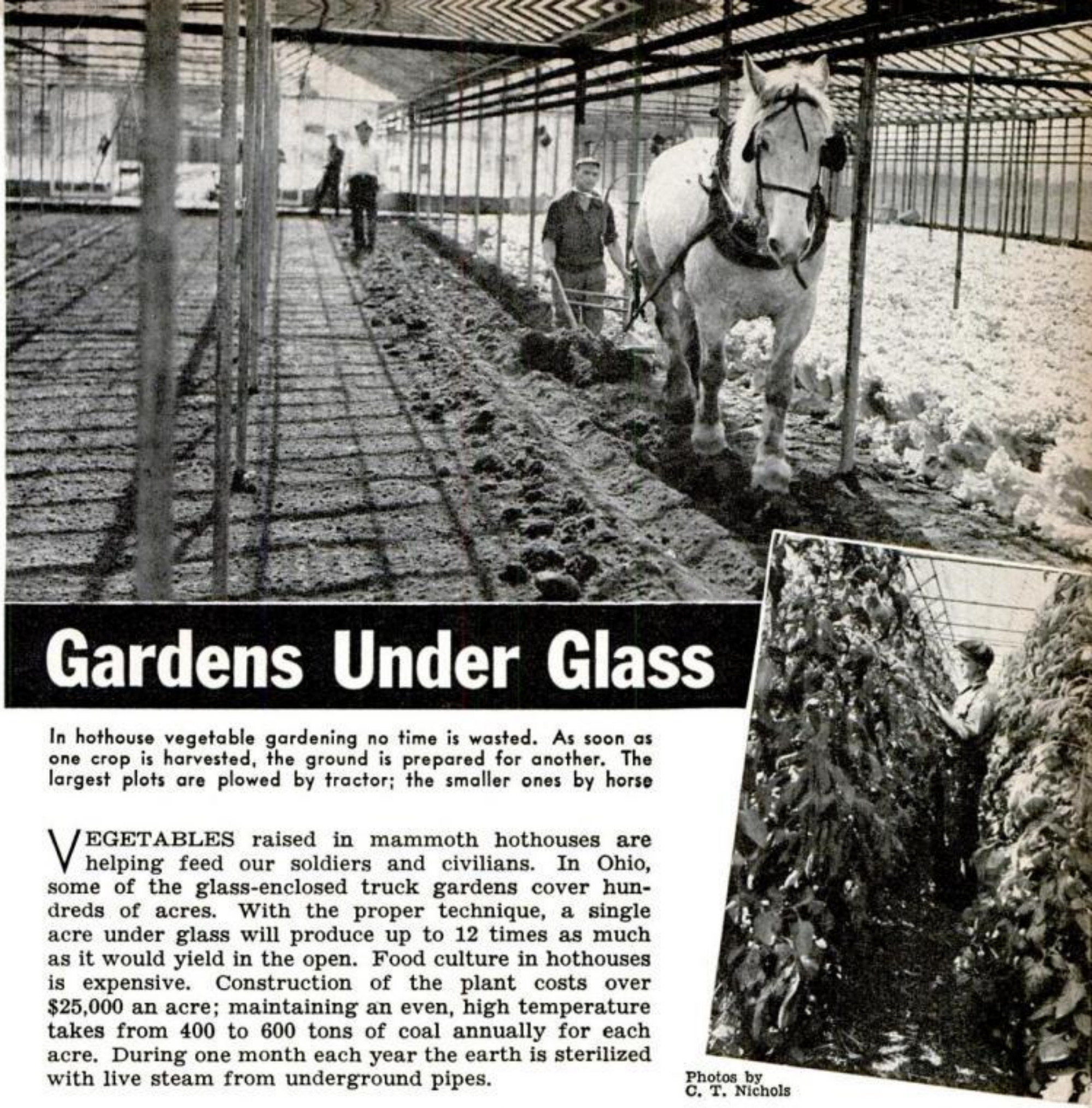
Westinghouse engineers in 1937 perfected a "key tube," said to be the final step in making early radar practical. This is understood to be the klystron tube, with which they demonstrated the power of ultrashort waves to light electric lamps at a distance. It was developed originally at Leland Stanford University by the brothers Russell H. and Sigurd F. Varian and others. Westinghouse men simplified it, reduced its bulk, and succeeded in projecting waves like a searchlight beam.

In their own field experiments, Westinghouse engineers discovered that highway traffic disturbed radio transmission between the company's works and its research laboratories a mile away. Each time a car passed along a highway between the two radio buildings, the signals rebounded.

The United States has trained many thousands of men in the operation of radar, and will train many more thousands, according to the General Electric Company. Early studies of the Heaviside layer, or "radio roof," contributed to radar development, points out RCA.

An "echo altimeter" demonstrated by the Bell Telephone Laboratories some years ago enables airplanes to avoid mountain-peak crashes by measuring their height above the ground, through the reflection of radio waves. Another predecessor of modern radar, it simply applies the principle upside down. Now it is the ground station that finds the height of the plane.

In time of peace, even the friendliest of nations keep such military secrets to themselves. But when war came, a British mission including Watson-Watt arrived in this country and placed at our disposal the plans of the British radio locator. Returning the favor, we let them know what we had been doing with radar. Notes were compared. Quite possibly—though this is pure conjecture—there evolved an Anglo-American radar better *(Continued on page 214)*



Gardens Under Glass

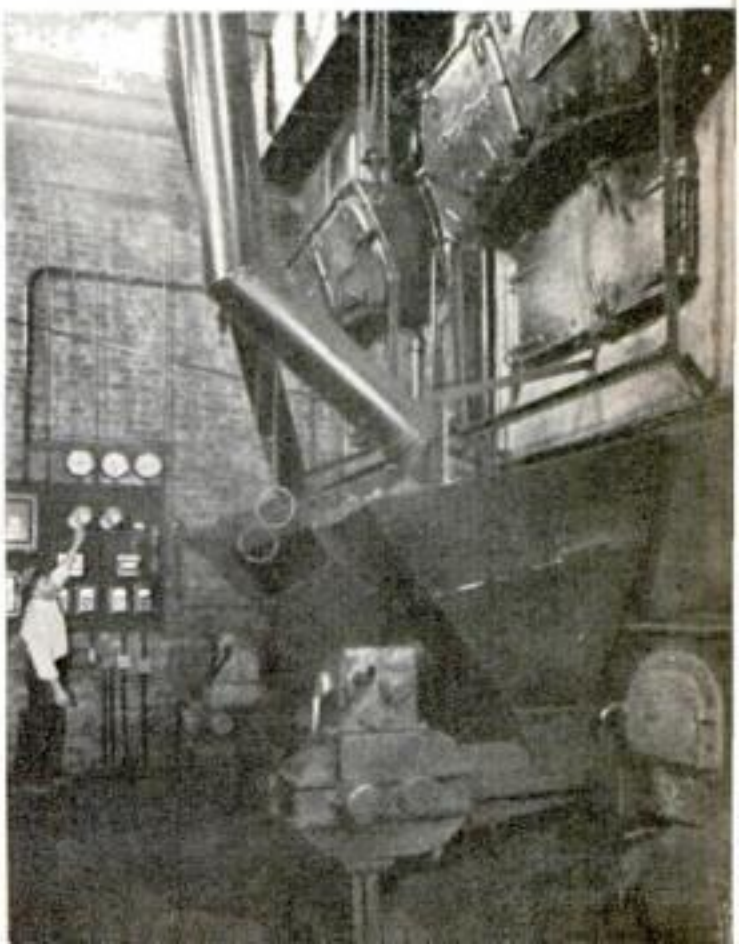
In hothouse vegetable gardening no time is wasted. As soon as one crop is harvested, the ground is prepared for another. The largest plots are plowed by tractor; the smaller ones by horse

VEGETABLES raised in mammoth hothouses are helping feed our soldiers and civilians. In Ohio, some of the glass-enclosed truck gardens cover hundreds of acres. With the proper technique, a single acre under glass will produce up to 12 times as much as it would yield in the open. Food culture in hothouses is expensive. Construction of the plant costs over $25,000 an acre; maintaining an even, high temperature takes from 400 to 600 tons of coal annually for each acre. During one month each year the earth is sterilized with live steam from underground pipes.

Photos by C. T. Nichols

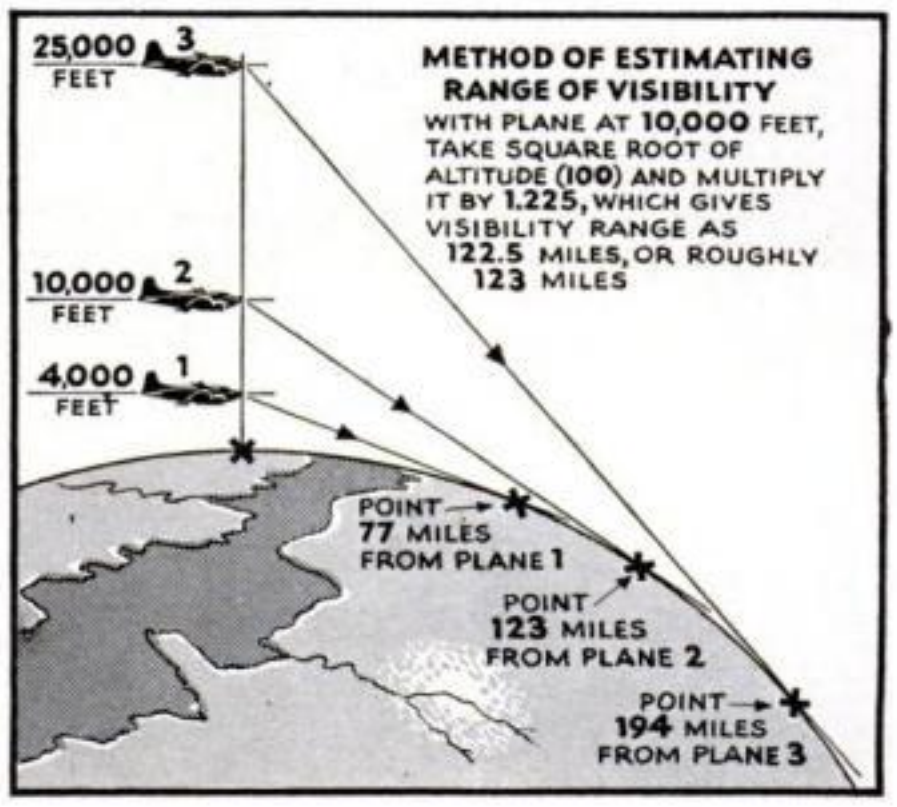
Lettuce and tomatoes are crops stressed by hothouse gardeners. Grown under glass, lettuce is cut in seven to 14 weeks. Tomatoes grow tall as Iowa corn. Below, lettuce is being packed in baskets for delivery. Above right, gardener among 10-foot tomato plants

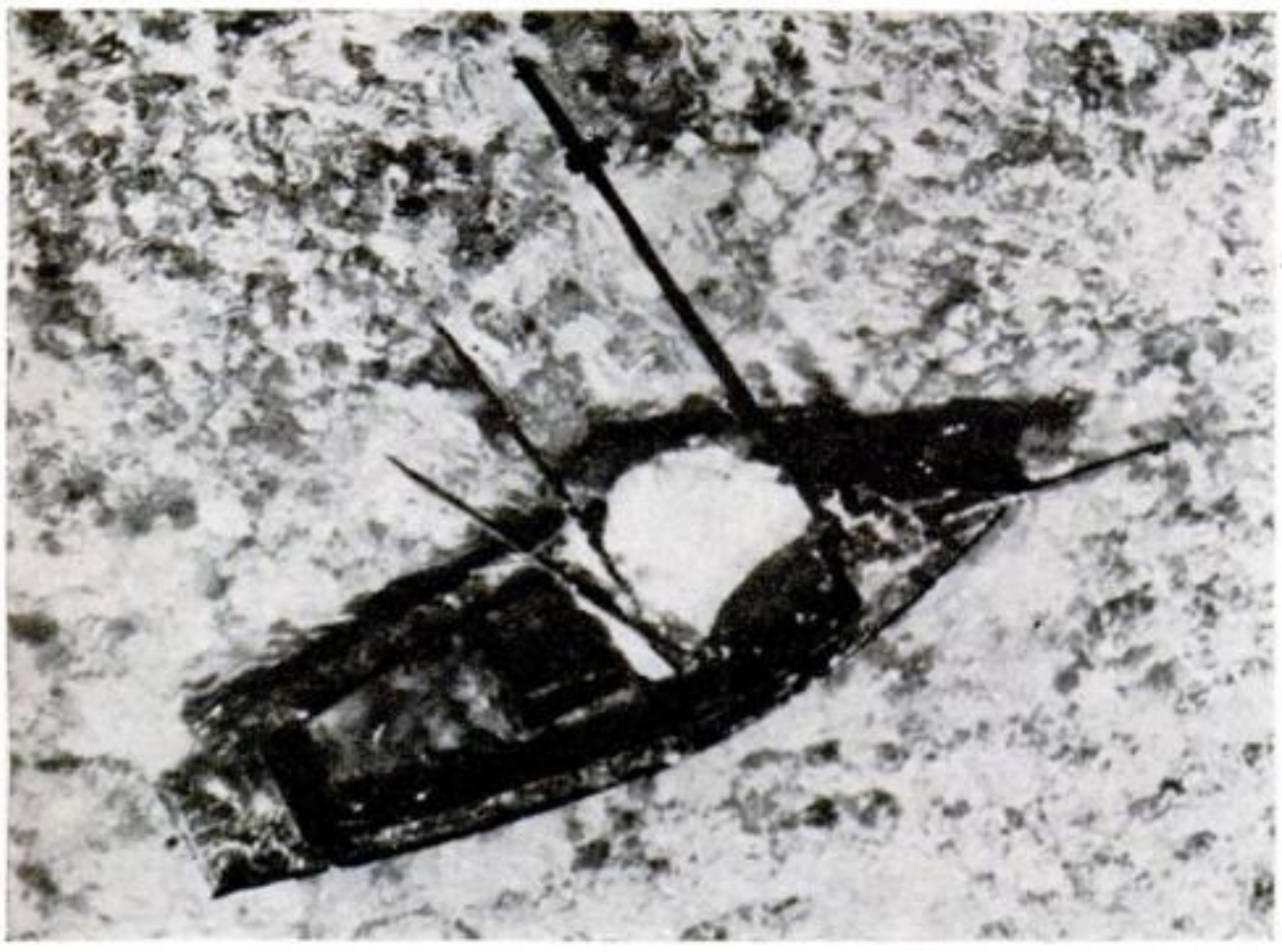
The heating plant of a hothouse is vital both in speeding up growth by keeping an even, high temperature and in sterilizing the soil with steam between crops



A WINDMILL WASHER, which he constructed out of odd pieces and mounted on an oil drum, has spared Pvt. Earl Krech, of South St. Paul, Minn.—now stationed in the Aleutian Islands—many a weary stint in the job of keeping his clothes clean. By means of a sprocket and chain, the windmill delivers power to wooden paddles which beat and swish his clothes around in a bucket of soapy water. All he has to do is hold the bucket while the paddles do their work. Private Krech, who built the machine soon after discovering that there was always "power" to be had in the windy Aleutians, found himself surprisingly popular among the men—until electricity was finally introduced into the encampment.

VISION-RANGE FORMULA. When Allied flyers, after bombing Germany at night, have reported, "Fires could be seen 150 miles away," have you wondered how it is possible to see at such a distance? Pan American Airways now answers that question with a formula worked out by its clipper captains and based on the curvature of the earth. Simply multiply the square root of the altitude by 1.225. For example, if flying at 10,000 feet, take the square root of that altitude, 100, and multiply it by 1.225, which gives you your vision range—122.5 miles. From 1,000 feet you can see 39 miles; 2,000, 55; 3,000, 62; 4,000, 77; 5,000, 82; 15,000, 150; 20,000, 173. A pilot flying at 25,000 feet can see into Germany while crossing the Channel.





SUNK, but still visible, is this sailing boat recently sighted by a Navy blimp on anti-submarine patrol off Cuba. Circling the area, the blimp discovered two men clinging to the tower of a beacon light. The blimp dropped food and water, and then summoned a Navy patrol boat to their rescue. This unusual photograph gives a good idea of how a sub, cruising near the surface in these waters, might appear to an observer in a patrol plane.

HINTS FROM THE MARINES ON

How to Keep Afloat

TO PREPARE them for the time when it may be necessary to abandon ship by jumping into the water, the U. S. Marine Corps is teaching its men how to get into the water safely and, once there, how to stay afloat by using pieces of clothing or equipment. Among other things, the men are taught to jump from the stern or bow to avoid being carried under if the ship capsizes, to discard their life jackets for swimming under burning oil, and to form groups in the water to reduce the danger of attack by sharks. This training was worked out by Staff Sergeant Harry F. McNamara, former swimming coach at the Massachusetts Institute of Technology.

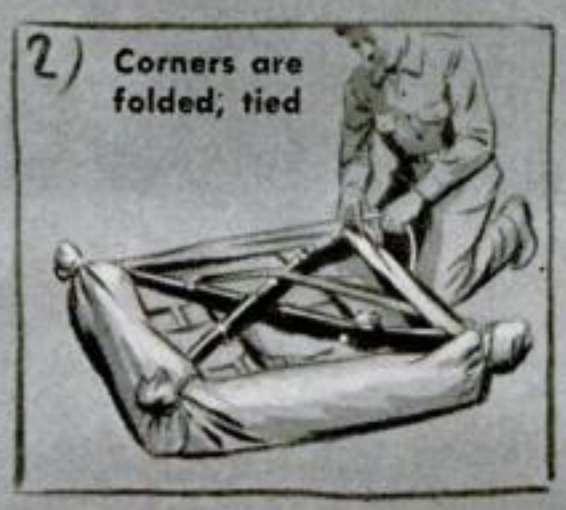
In jumping into the water, men are taught to hug life jackets to keep them from tearing loose

With his leg through the handle of an inverted pail, a man can stay afloat for hours

A wet mattress cover may be partially filled with air and tied at open end to make an emergency raft

Trousers removed in water, knotted at cuffs, and whipped over head to inflate, provide good water wings

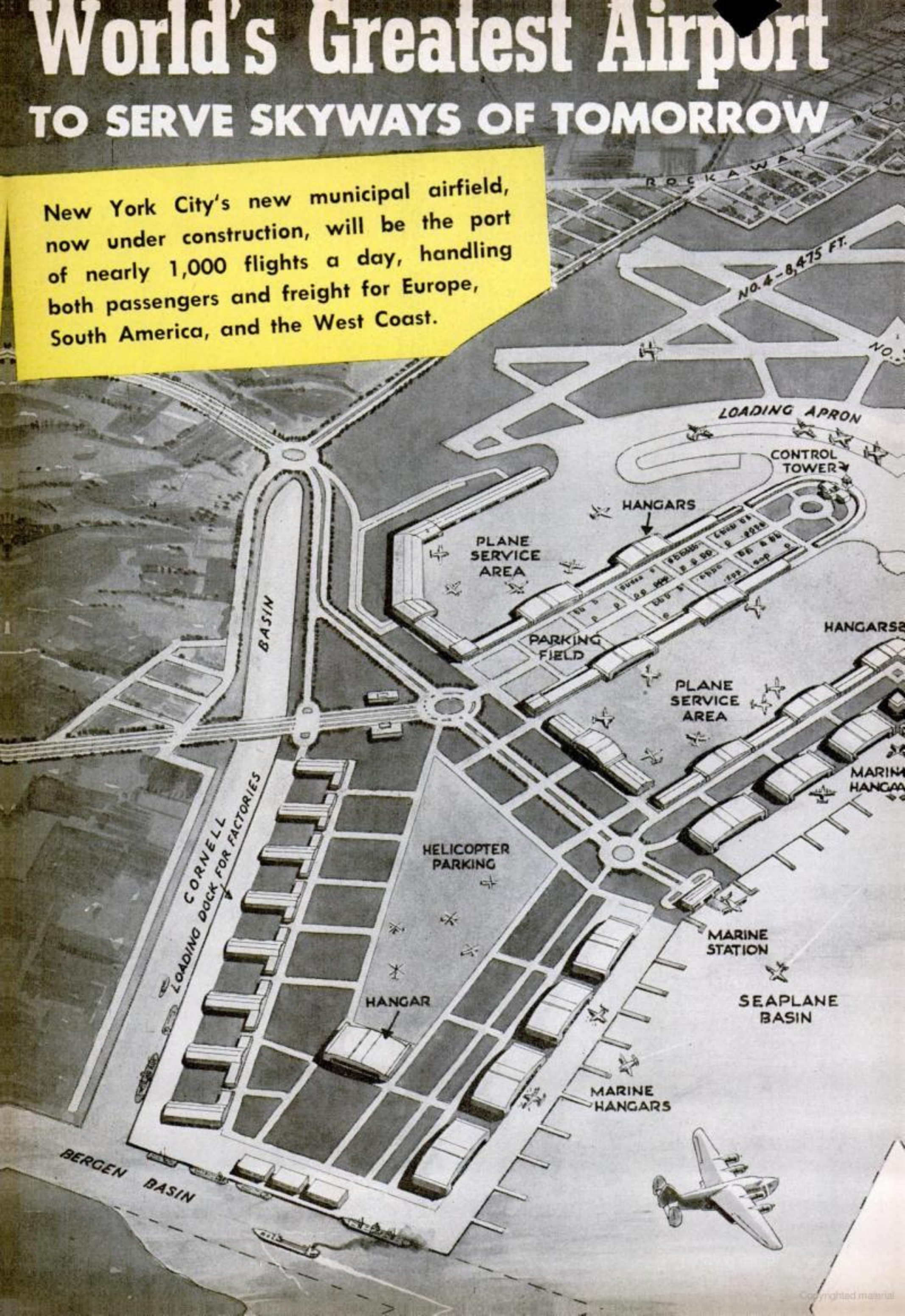
A helmet and its lining can be separated to capture air and serve as a pair of buoyant floats

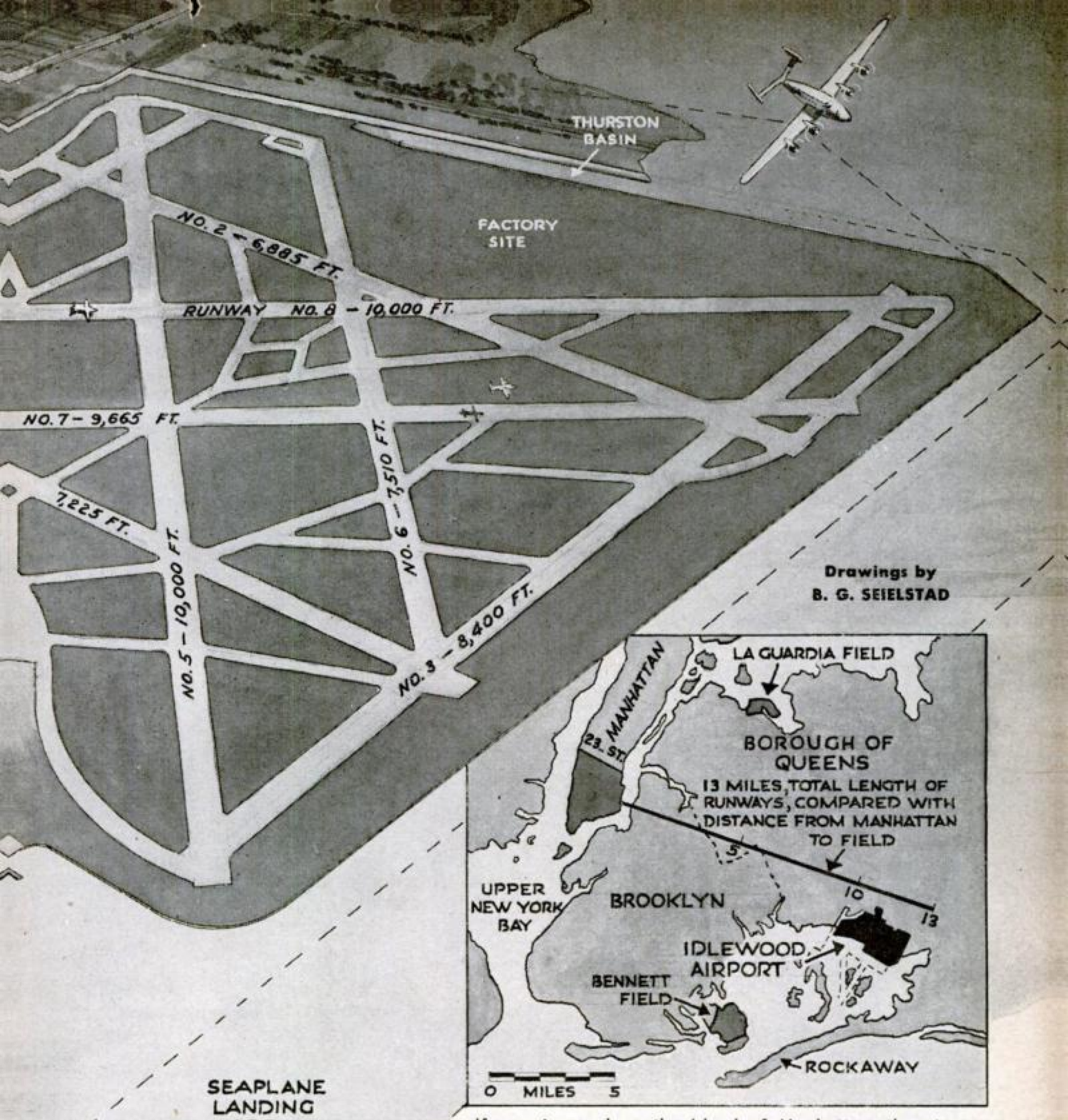


World's Greatest Airport

TO SERVE SKYWAYS OF TOMORROW

New York City's new municipal airfield, now under construction, will be the port of nearly 1,000 flights a day, handling both passengers and freight for Europe, South America, and the West Coast.





If superimposed on the Island of Manhattan, the giant airport now under construction on the north shore of Jamaica Bay would reach from 23rd Street to the Battery

A GIANT skyways depot containing the whole pattern of future air transportation is taking shape on our eastern seaboard. It's destined to be the world's biggest and most modern airport—a formidable adjunct to America's bid for postwar aviation supremacy. Yet so quietly is it progressing that few know of its whereabouts, let alone its size or significance.

This is the second aerial wonder project of New York's Mayor F. H. La Guardia and his city planners. Just 10 miles to the north, across the Borough of Queens, the first great municipal field bearing his name handles more traffic than any other city airport in the land. It was regarded as mammoth when opened three years ago; but the new airport, with its 2,576 acres, has five times the area, and its design for traffic may turn up the clock a decade.

Some of the Mayor's predictions:

"Scheduled flights that begin or end at the new terminal will reach the staggering total of 950 daily. They will include landings and

Drawing from scale model made by

Enough sand to fill a city block a mile high has been taken from Jamaica Bay to lay the field's foundation

Into the original layer of straw, poles were driven to show height of sand, which was laid on next. Covering the sand will be concrete—enough to construct a 20-foot highway 250 miles long

take-offs by super cargo and passenger planes weighing up to 150 tons.

"Every hour on the hour a big airliner will hop off for a trip across the Atlantic.

"Week-end jaunts to London and Paris will be as easy, if not as common, as visits from New York to Atlantic City are now.

"Children in New York will get fresh tree-ripened bananas and other tropical fruits, so vital to health, at one third the present price each day by air from the West Indies or Central America."

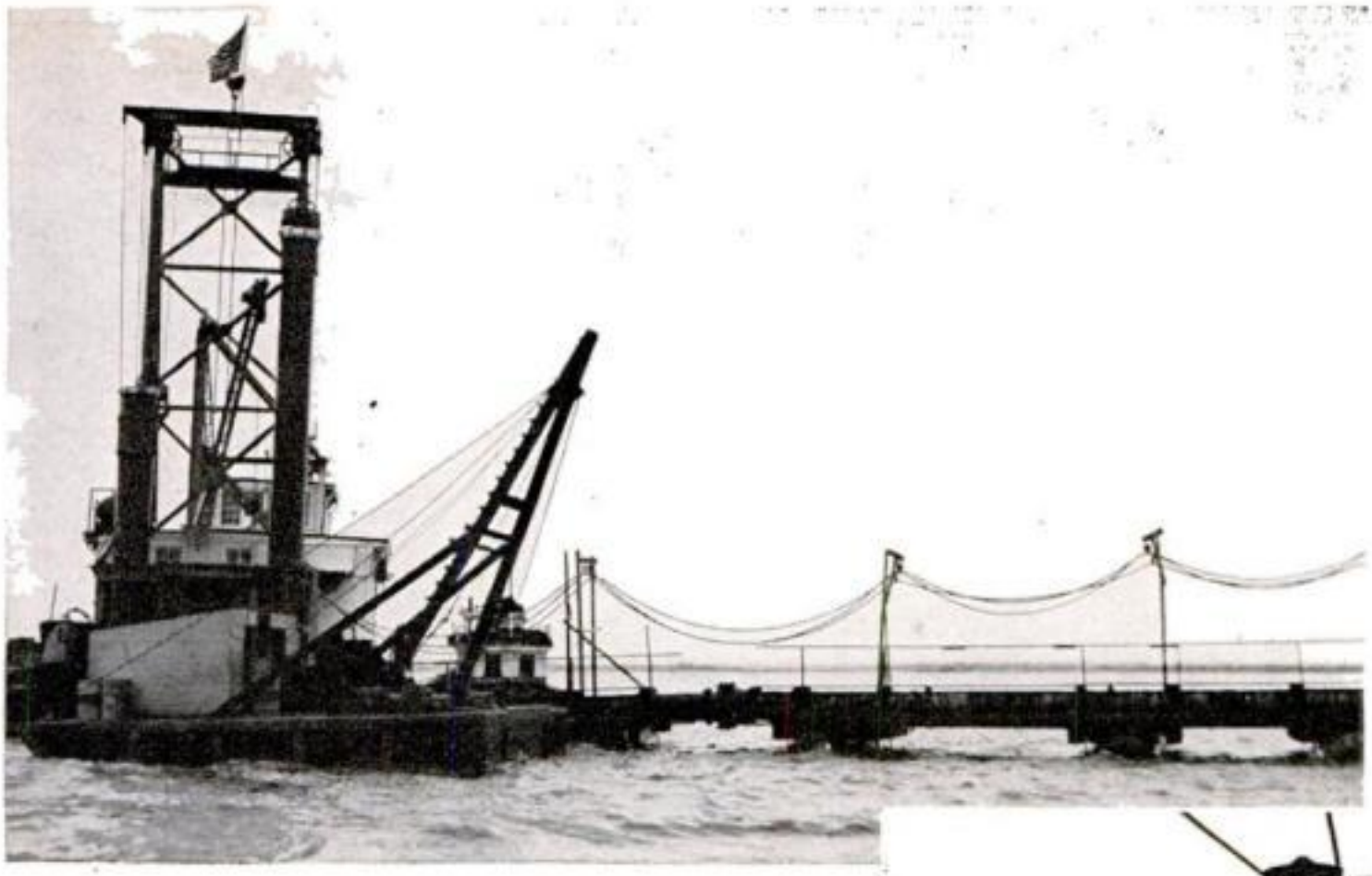
When the new airport, with its 13 miles of concrete runways for land planes and three huge landing areas in Jamaica Bay for seaplanes, begins operation, it will relieve La Guardia Field of international and transcontinental traffic. But the Mayor predicts both will be kept busy. La Guardia Field will get flight schedules for all short hauls on the East Coast, and those west to Chicago and north to Montreal.

Atop 10 feet of hard-packed sand that covers the field, workers will pour enough concrete for runways to build a highway 20 feet wide from New York to Washington. Never have there been such giant strips. The runways, each 200 feet wide, will be laid in pairs in four wind directions. Planes will be able to land and take off simultaneously on each pair of runways. The three largest runways will be two miles long, the longest in the world. Concrete will be 12 inches thick on all runways and on the five miles of taxiways, 100 feet wide, connecting the runways. The seaplane landing areas will be two miles long and 1,000 to 1,500 feet wide.

Everything is being done to make this airport the greatest. The designer, Jay Downer, his engineering and architectural associates, and John McKenzie, New York's Commissioner of Marine and Aviation, have tapped the nation's pool of aviation knowledge. Every plan and blueprint looks to the demands of the future.

Structures necessary to handle the contemplated traffic at the airport stagger the imagination. There must be, in addition to the giant control tower and ticket offices of aviation companies, buildings for United States customs and immigration authorities, communications, storage warehouses, hangars, restaurants and cafeterias, and concessions. Ten thousand people are expected to commute there daily from the city and suburbs.

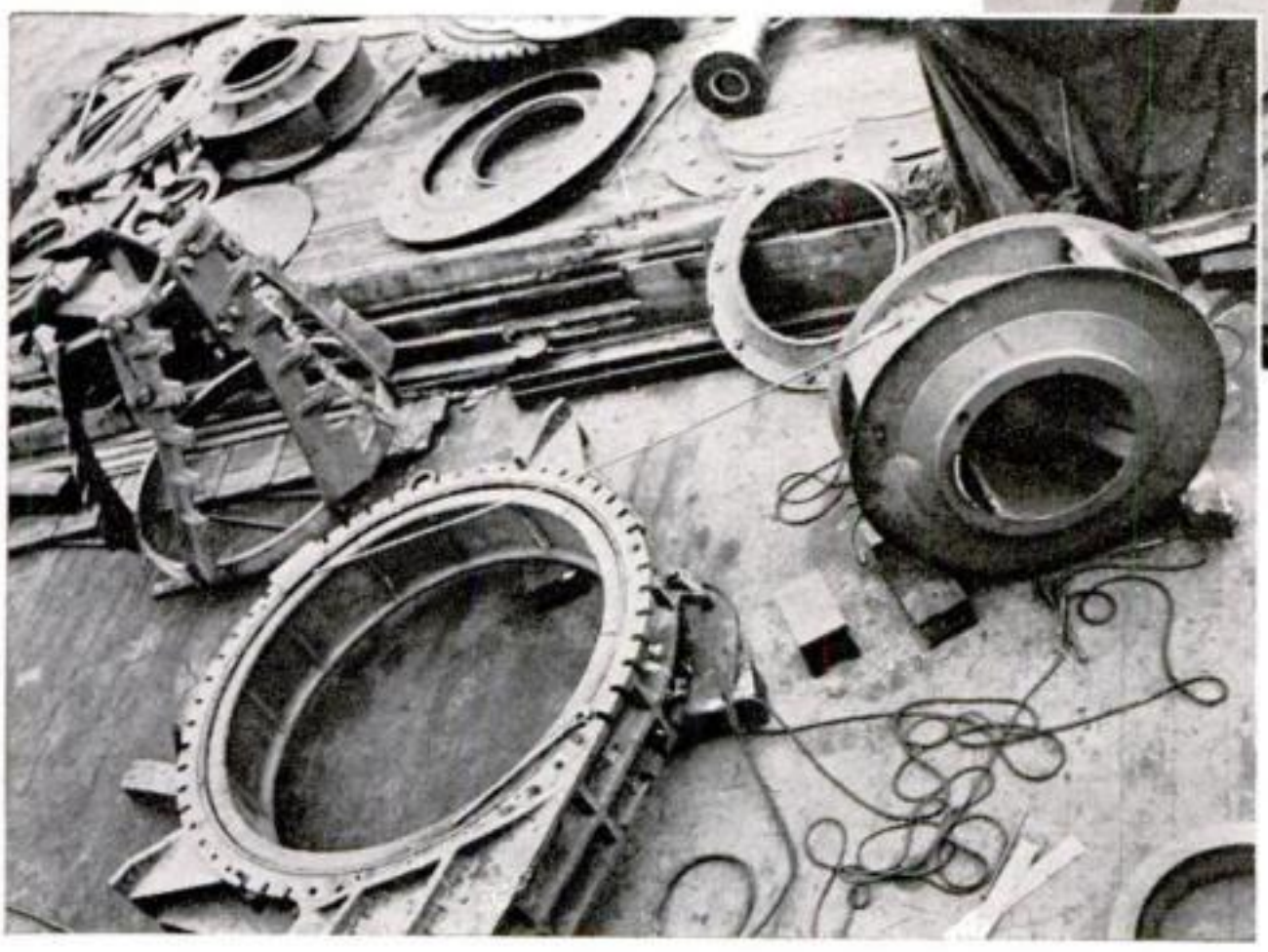
Passenger and freight schedules will be arranged to eliminate conflict. The bulk of the passenger traffic probably will be routed mornings, afternoons, and early evenings,



Working 24 hours a day, giant dredges have dug up 23,000,000 cubic yards of sand for the field—and at the same time cleared seaplane landings from 15 to 40 feet deep. Sand was carried ashore by pontoon-floated pipes

with freight haulage moving late at night.

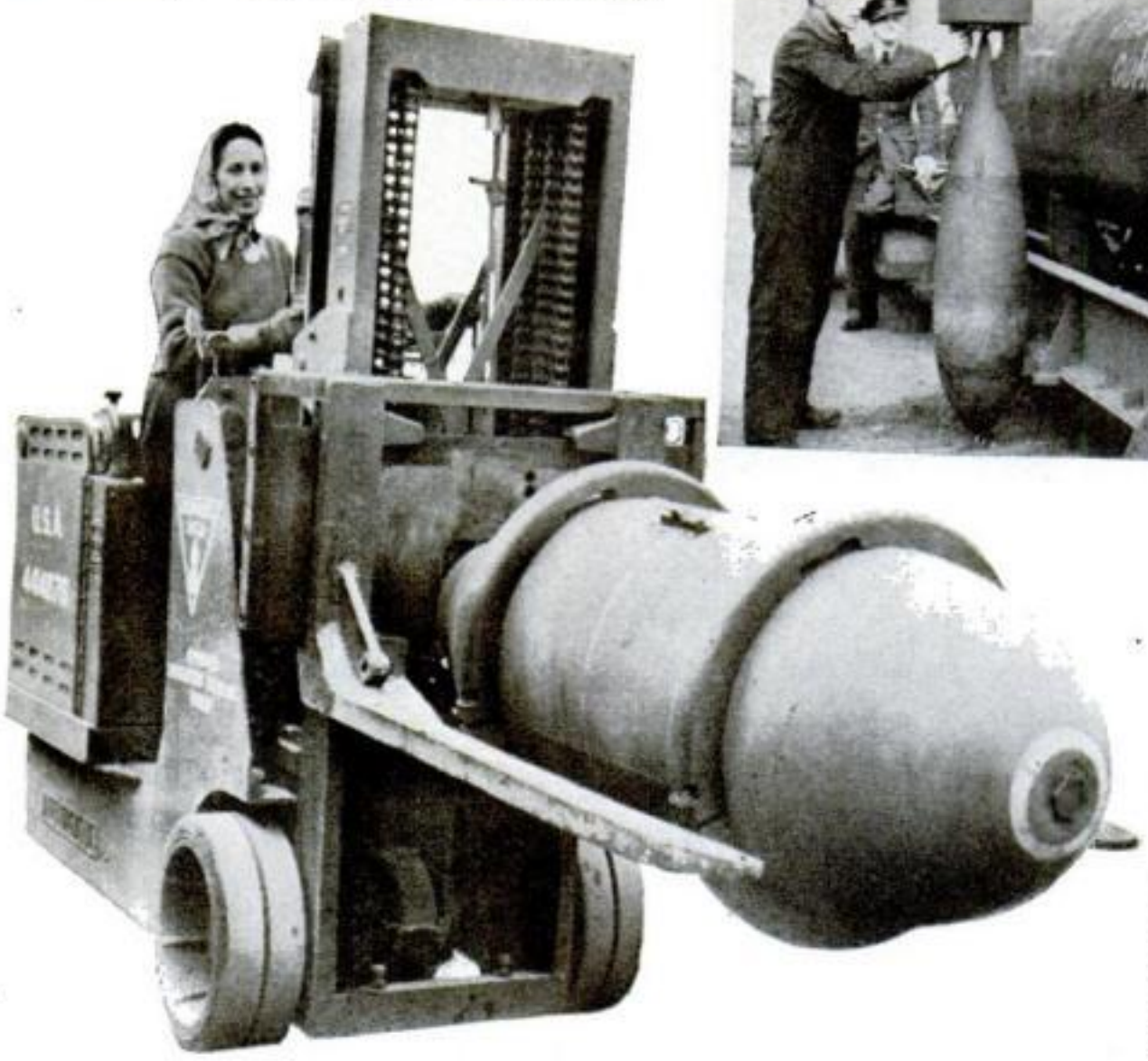
Other innovations: Portable control towers are planned as auxiliaries to the main control tower to overcome limited vision caused by the huge size of the field; "nose hangars" may be built instead of conventional hangars to protect planes, thus saving millions of dollars in material; fog-busting radio mechanisms may make it possible for planes to land and take off in bad weather; a system is planned in which passengers may be saved all walking to and from planes by a new-type "chariot" with built-in gangway; landing space is provided in parking areas for helicopters to shuttle in with passengers from the very heart of Manhattan, from La Guardia Field, and from other points.—JACK O'BRINE.



Markers on the dredges are lowered into the water to measure the depth to which bay bottom has been cleared

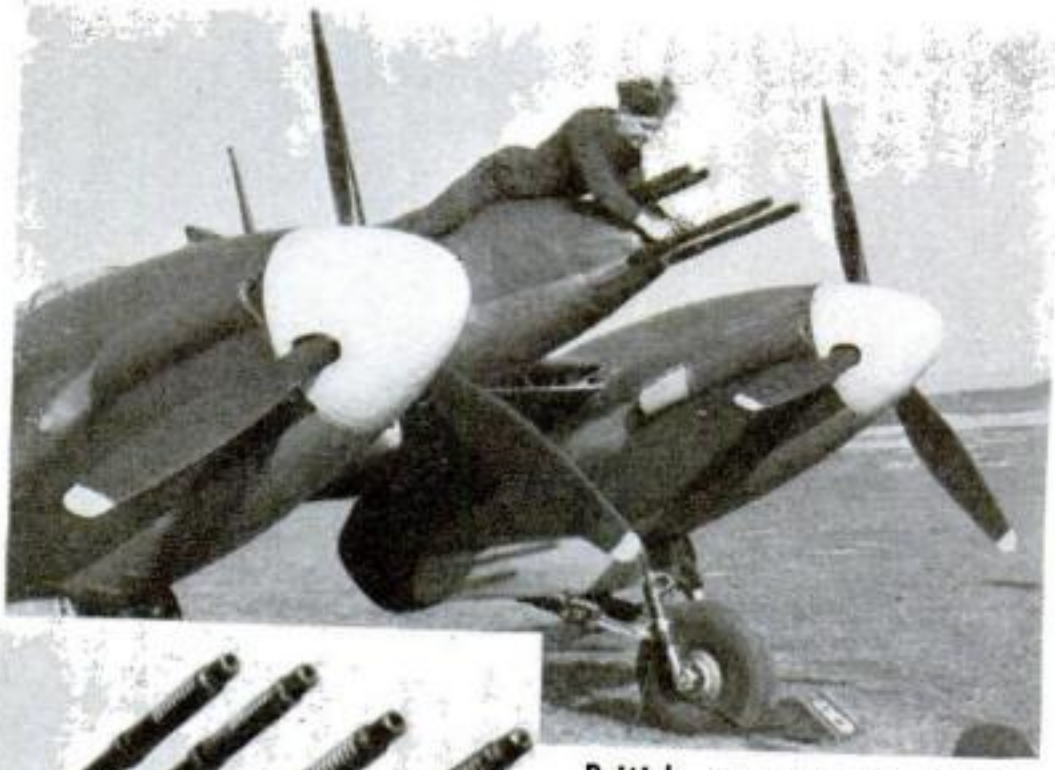
The circular "toothed" instrument shown in the foreground is the electrically driven "cutter" which, at the end of the suction tube lowered into the bay, chops loose the bottom so that it can be sucked to the surface

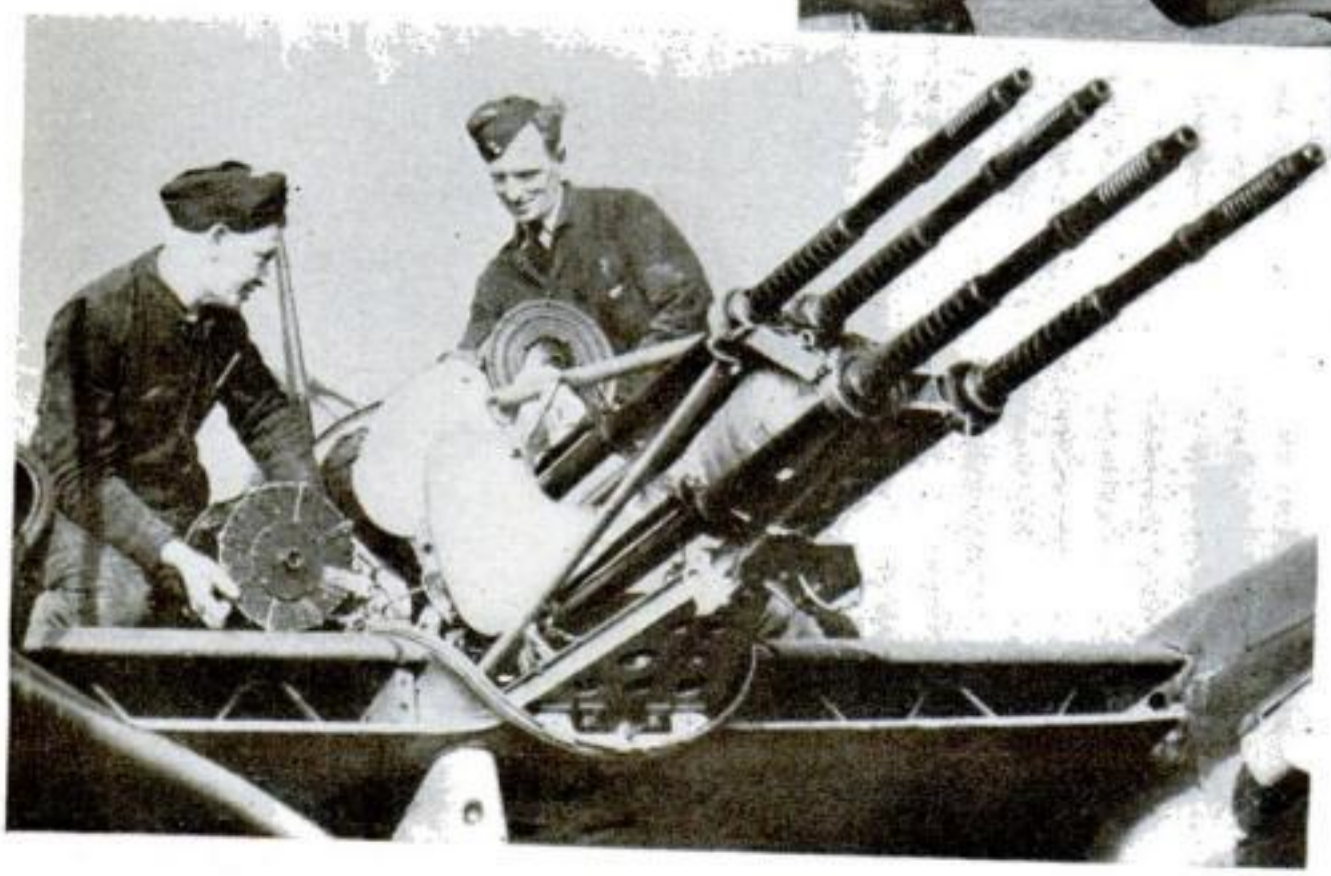
Bad-news pictures for Japs and Nazis are these of British and American block busters. Right: the R.A.F. look over an 8,000-pounder. Below, a worker lifts a 2,000-pounder



BLOCK-BUSTER BOMBS are more often heard about than seen by civilians. Some idea of the size of our deliveries to our enemies is gained here. Above, a British 8,000-pound bomb is gauged by a 500-pound one. Left, an American 2,000-pounder is loaded at Seneca Ordnance depot, New York, with a mechanical lift.

A FIGHTER WITH FOUR ARMS, and one that pulls no punches, is the new British Whirlwind fighter-bomber, which is proving such a terror to the enemy with its day and night attacks. In the nose of this ship are mounted four Hispano-Suiza cannons. Squadrons of these planes have proved their power by destroying, within a period of six months, 37 war-goods trains, successfully attacking power stations and viaducts, and destroying shipping in enemy waters.



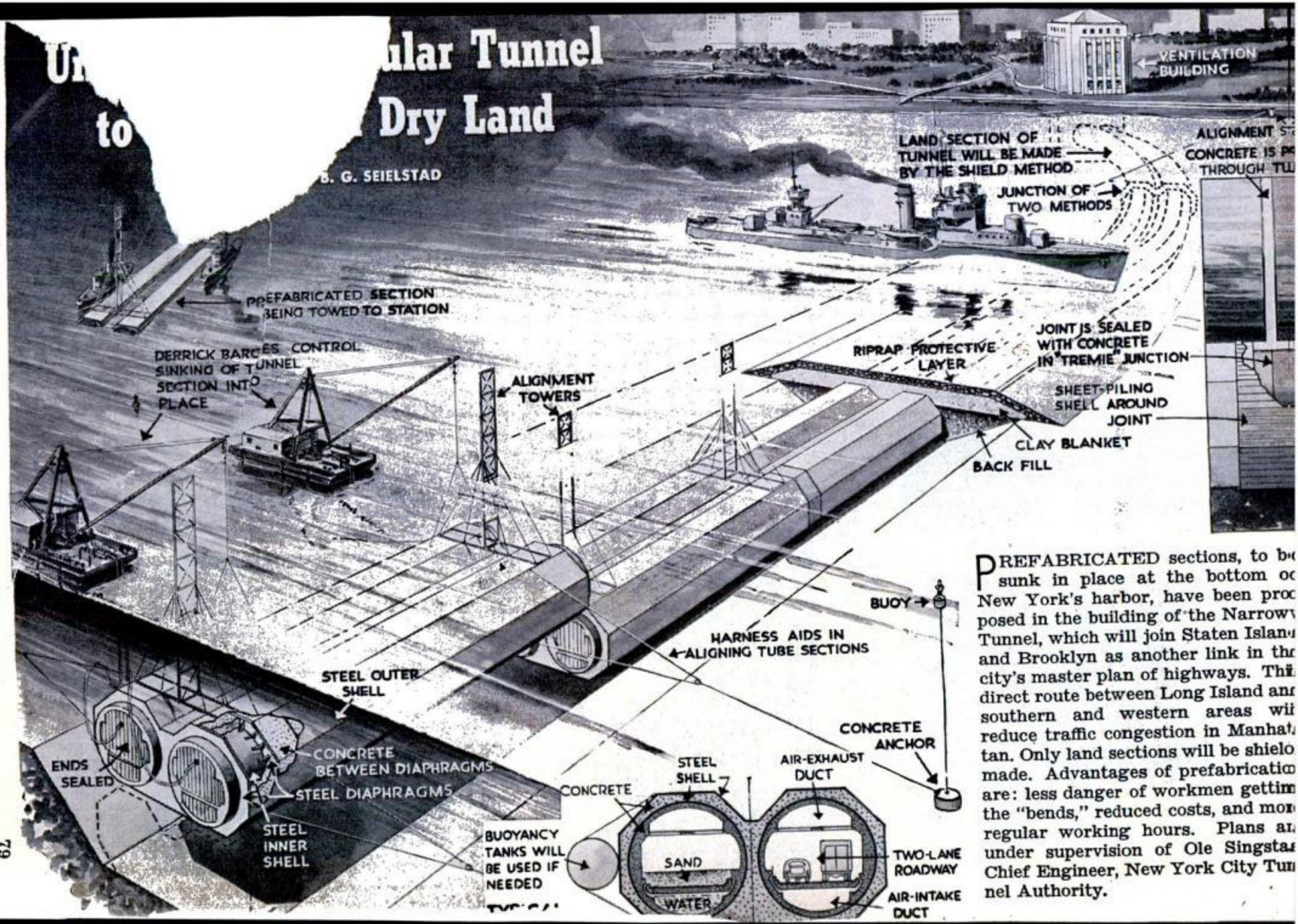


British armorer is shown at work on the four Hispano-Suiza 20-mm. cannons that are mounted in the nose of the new British Whirlwind fighter-bomber

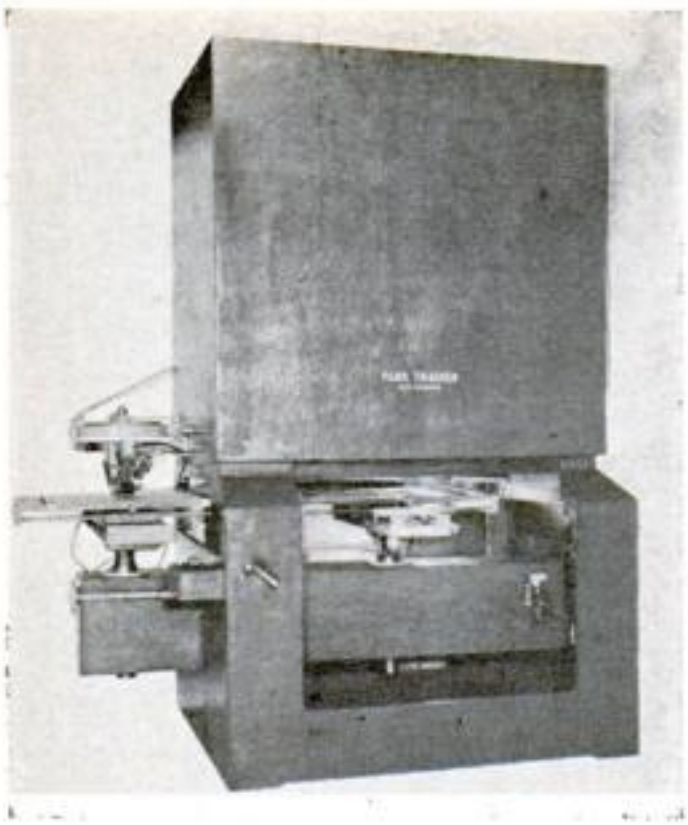
Loading up the guns on a Whirlwind. A close-up of the mounting of the cannons which make this fighter so effective a weapon against enemy industry and life lines

U... to ...ular Tunnel ... Dry Land

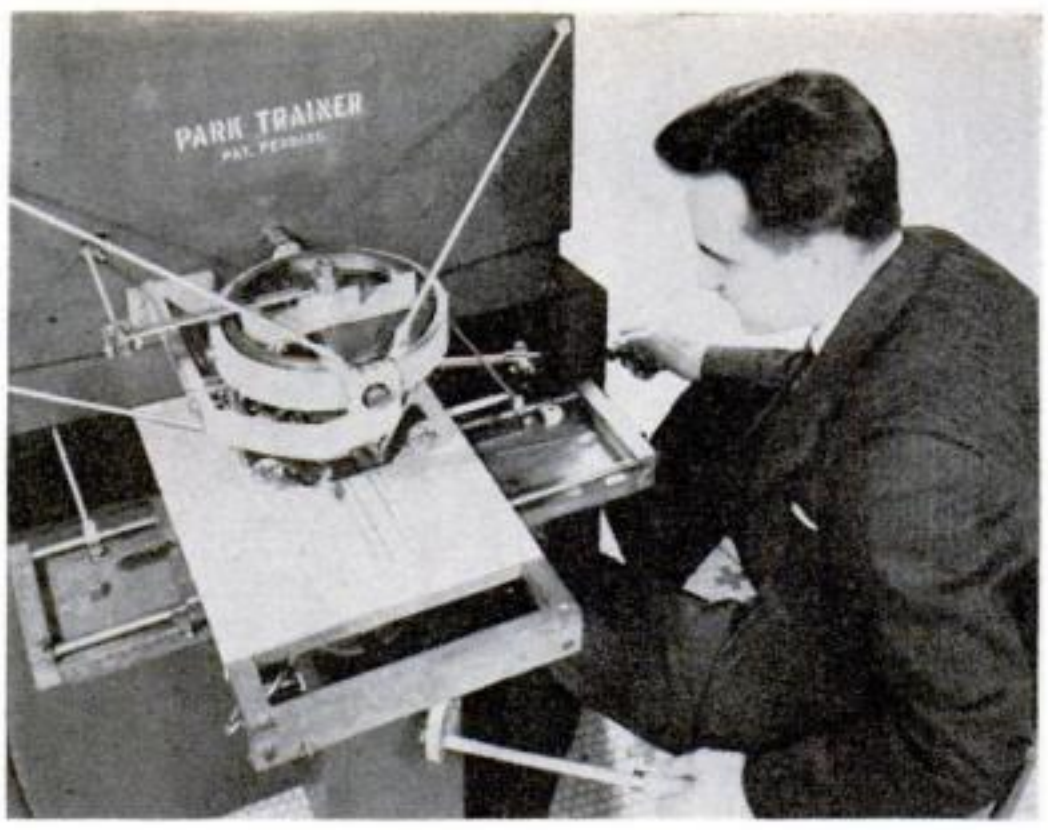
B. G. SEIELSTAD



PREFABRICATED sections, to be sunk in place at the bottom of New York's harbor, have been proposed in the building of the Narrows Tunnel, which will join Staten Island and Brooklyn as another link in the city's master plan of highways. This direct route between Long Island and southern and western areas will reduce traffic congestion in Manhattan. Only land sections will be shielded made. Advantages of prefabrication are: less danger of workmen getting the "bends," reduced costs, and more regular working hours. Plans are under supervision of Ole Singstad, Chief Engineer, New York City Tunnel Authority.



The trainer, showing the wholly enclosed cabin at the top in which the student sits



A recorder shows the student's camera adjustments while an instructor produces "tilt" and "crab" with hand controls

AERIAL-PHOTOGRAPHY TRAINING that can be carried on regardless of weather conditions has been made possible by a laboratory trainer invented by W. Sidney Park, president of Park Aerial Surveys, Inc., Louisville, Ky. A wholly enclosed cabin, in which the trainee sits, is equipped with an aerial camera, a view finder, and a film transparency that can be operated to give the illusion of ground passing under a plane. Sitting at a cabinet on which the cabin is mounted is the instructor who, by means of hand controls, rocks the cabin from side to side and rotates the vertical shaft on which the film transparency rests. This causes what are known as "tilt" and "crab," and requires the student to make adjustments of his camera on its vertical as well as its longitudinal and latitudinal axes. Recordings are made of the difficulties the instructor has imposed, the student's adjustments of the camera, and his timing of "shots" to provide a continuous record of ground area by fitting separate pictures together. Costing but a few cents an hour, as compared with the $50-an-hour expense of actual flight training, this laboratory training enables the instructor to point out errors the moment the student makes them instead of having to wait until the photos are printed.

DEAD R
Forces N
of an e

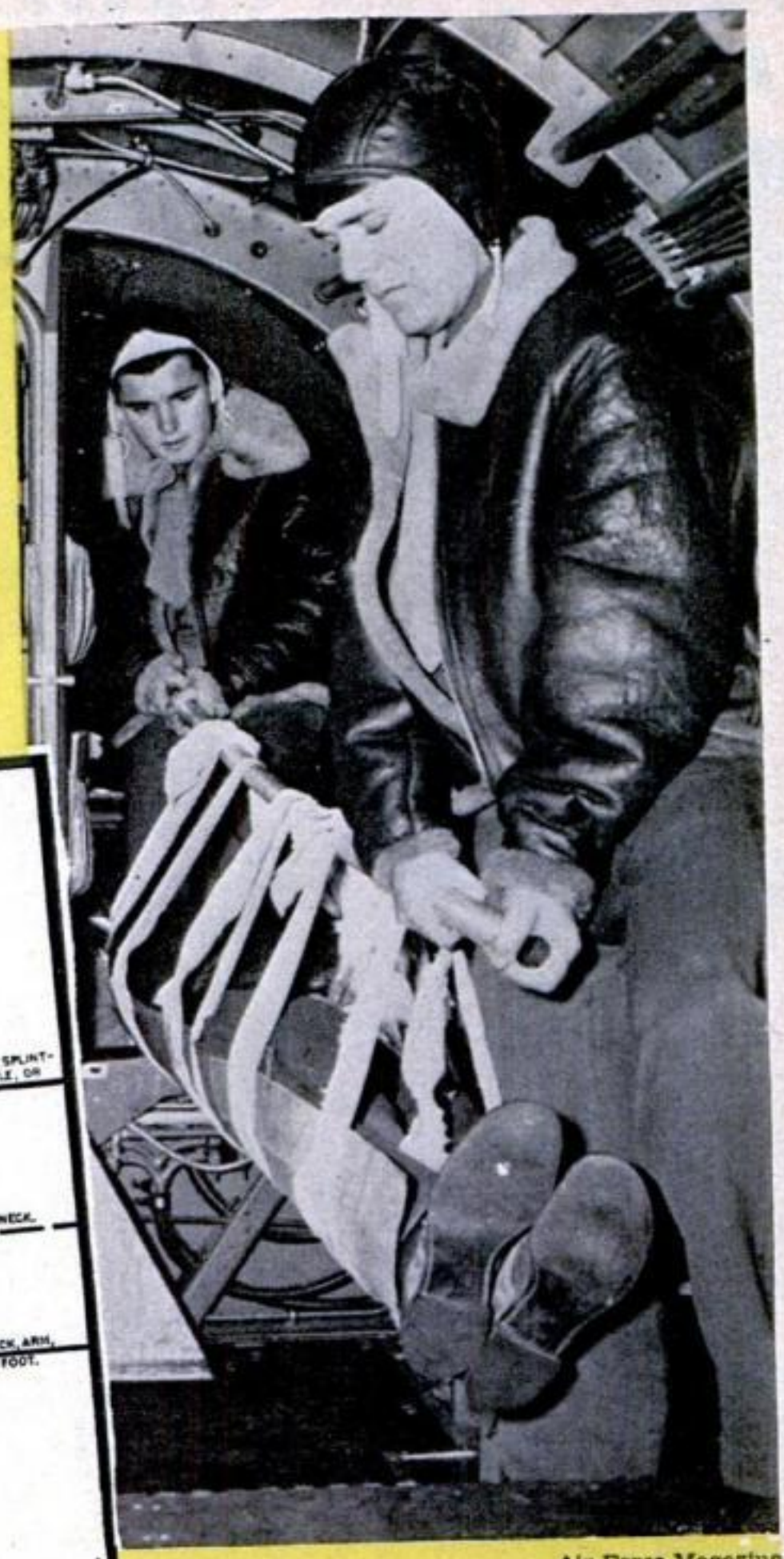
A cadet gets final instructions bef
being enclosed for 15 minutes of "bl
flying." At right, trainees are sho
going through a drill. Their computa-
tions are carefully checked by experts

CKONING is being taught
Navigation School at Hondo, Tex.,
closed device in which the cadet sits
s computations from instruments identi
e found in a plane. Invented by Col. Carl
me "Navi-trainer" affords intensive training
flying, only 16 hours of "ground navigation"
equired before a cadet takes to the air.

POPULAR SCIENCE

All-in-One Splint Helps First-Aiders

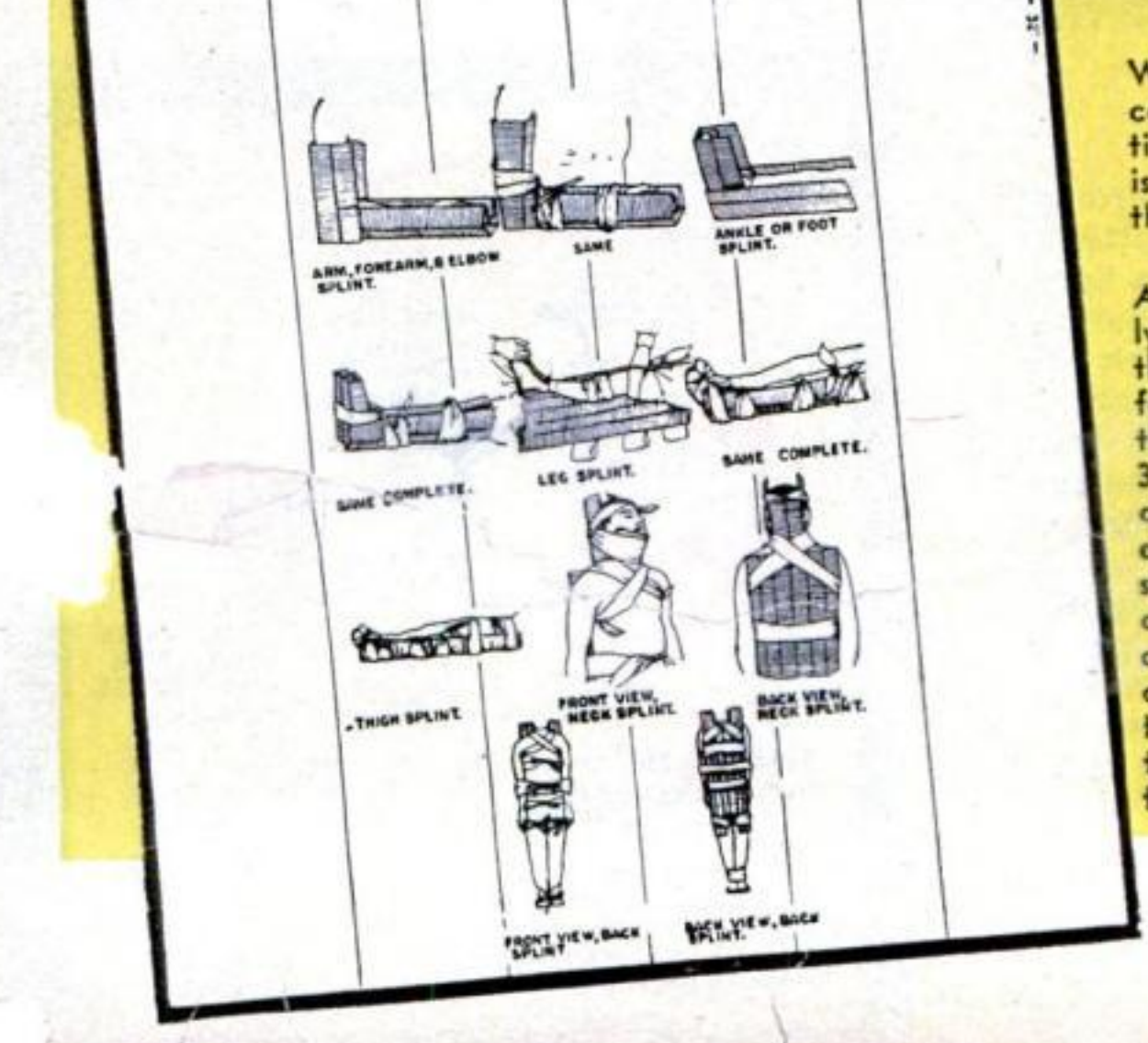
FOLLOWING the old adage that one picture is worth a thousand words, Major Walter J. Crawford, U. S. Medical Corps, has devised, as an addition to standard aeronautical medical kits, a piece of common cardboard on which explicit diagrams show how it can be made into a splint for various parts of the body. Each board is accompanied by three triangular pieces of cloth, on each of which are printed diagrams to illustrate their use as bandages and tourniquets.



Air Force Magazine

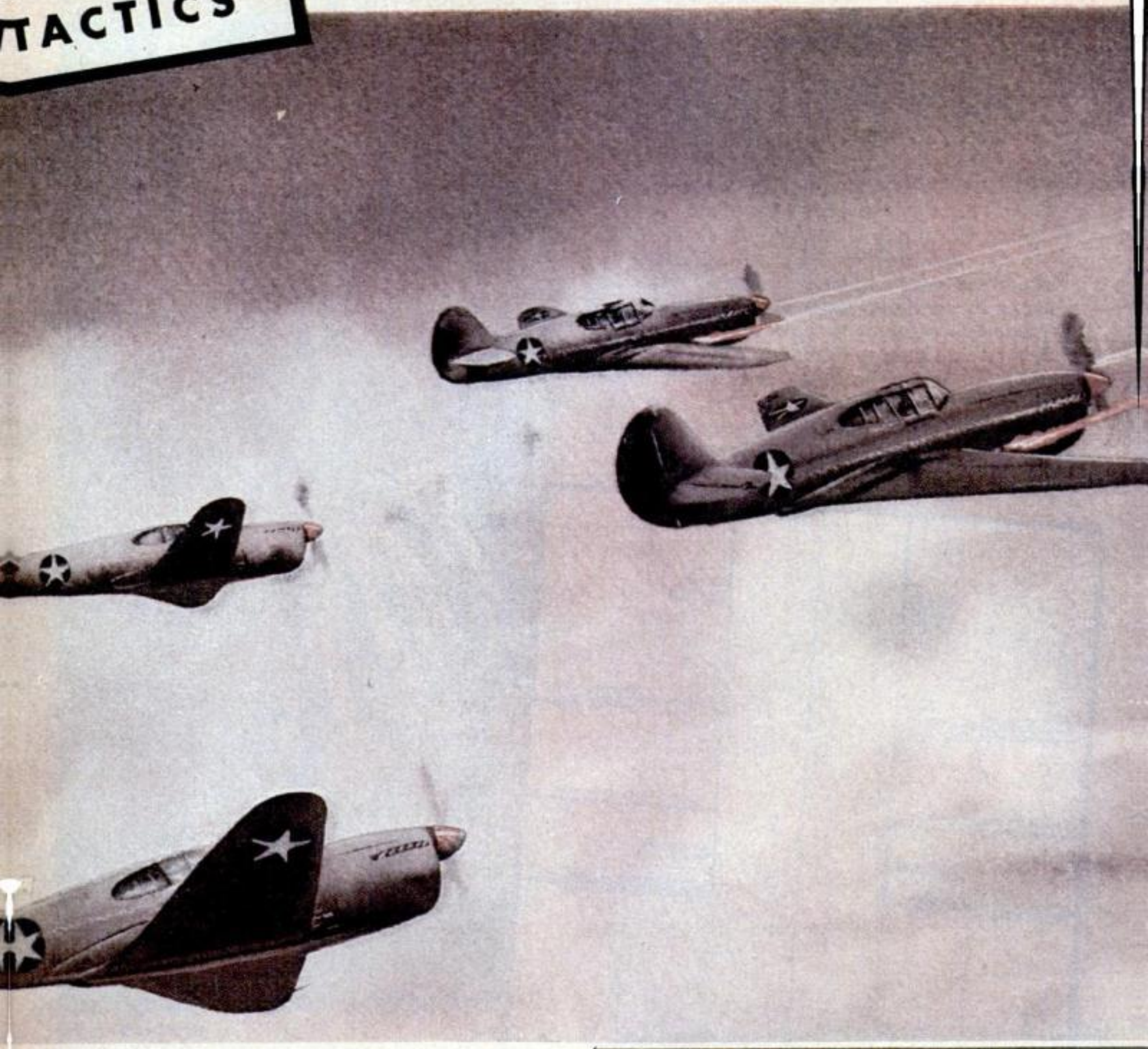
When used as an emergency stretcher, the cardboard splints and cloths make a particularly handy carrier, especially when it is necessary to maneuver a wounded man through the narrow passages of a bomber

At left, the cardboard splint carefully marked and diagramed so that even the most unpracticed hands can cut and fold it, and then apply it as shown at the bottom. Each board, which is 16 by 32 inches, is accompanied by three triangular cloths, known as "cravats," on each of which are printed 30 drawings showing how they may be used as bandages or tourniquets, to be self-applied or used on another person. On the back of each cardboard are detailed instructions on how to carry a wounded man, how to give artificial respiration, and the treatment for burns, shock, and fractures



FIGHTER TACTICS

Teamwork Wins



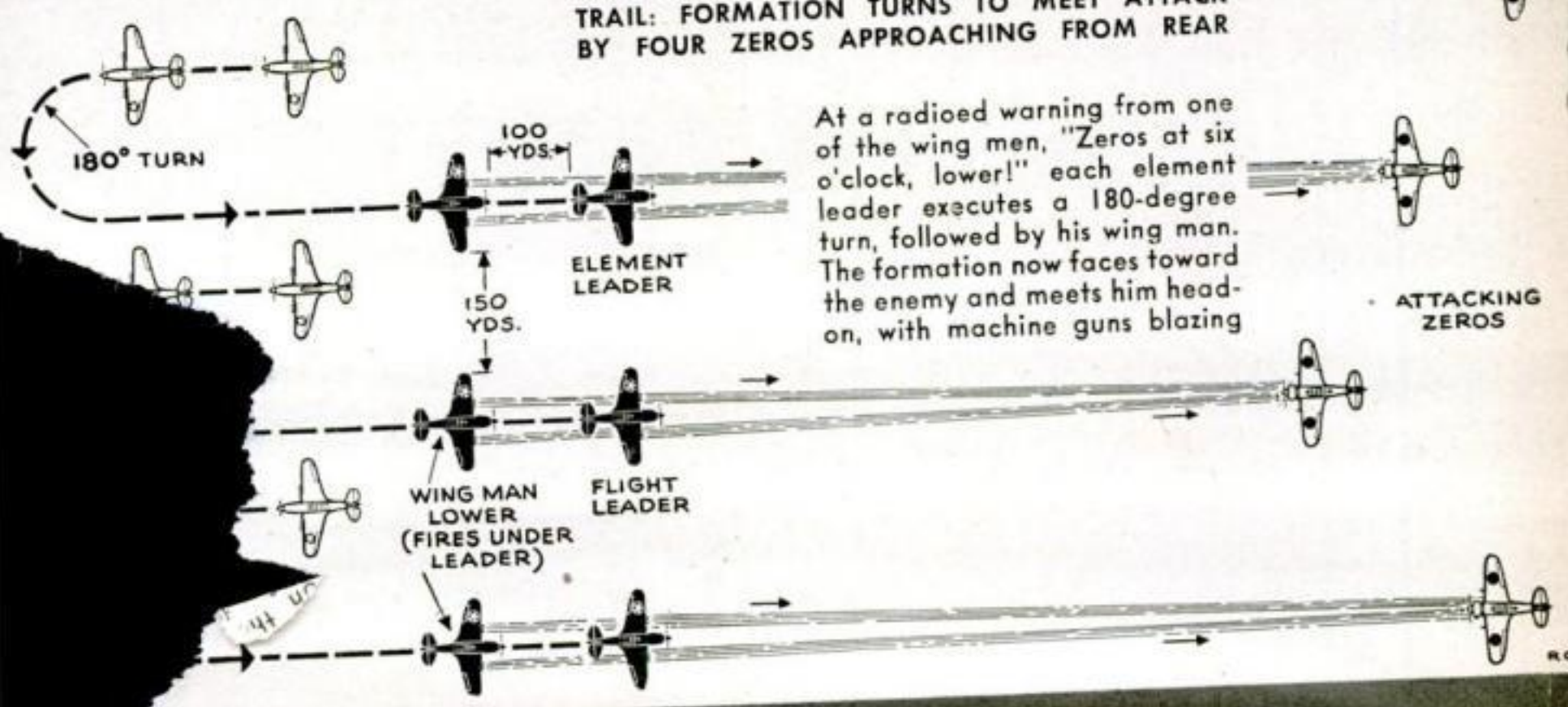
By STEWART ROUSE

FLYING a single-seater fighter plane through air battles at 350 miles an hour or better is one of the most exacting jobs a man can have. His plane is essentially a winged gun mount. The weapons with which it does its work are aimed by pointing the ship itself at its target, so that the flyer is pilot and gunner in one; his life depends on the skill with which he can bring his fire power to bear on the enemy and keep clear of the answering hail of steel. Single combat is out; the basic unit of fighter tactics is the two-plane element, or "pair," consisting of leader and wing man. Even if the formation is broken up, the pairs stick together. The luckless flyer who loses his mate will have a Jap or a Nazi on his tail in no time. These six pages show how various formations are maneuvered to meet different situations in both defensive and offensive action.

Battles in the Sky

A flight of six P-40's engages four Zeros as it completes a 180-degree turn to meet attack from the rear. Wing planes are wheeling into line

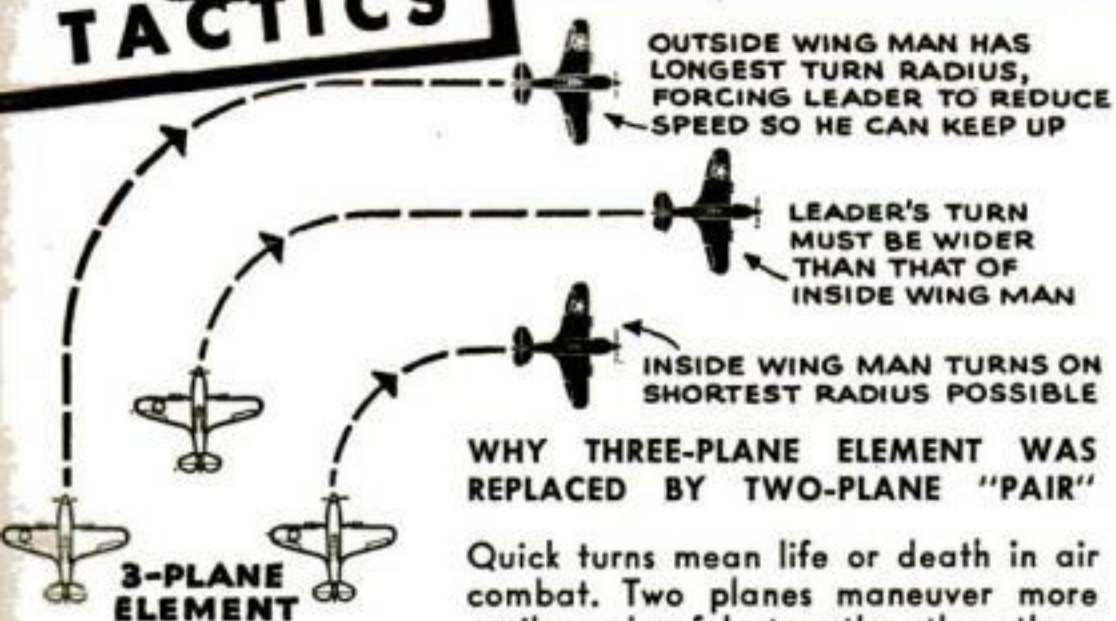
ELEMENTS IN LINE ABREAST, WING MEN IN TRAIL: FORMATION TURNS TO MEET ATTACK BY FOUR ZEROS APPROACHING FROM REAR



At a radioed warning from one of the wing men, "Zeros at six o'clock, lower!" each element leader executes a 180-degree turn, followed by his wing man. The formation now faces toward the enemy and meets him head-on, with machine guns blazing

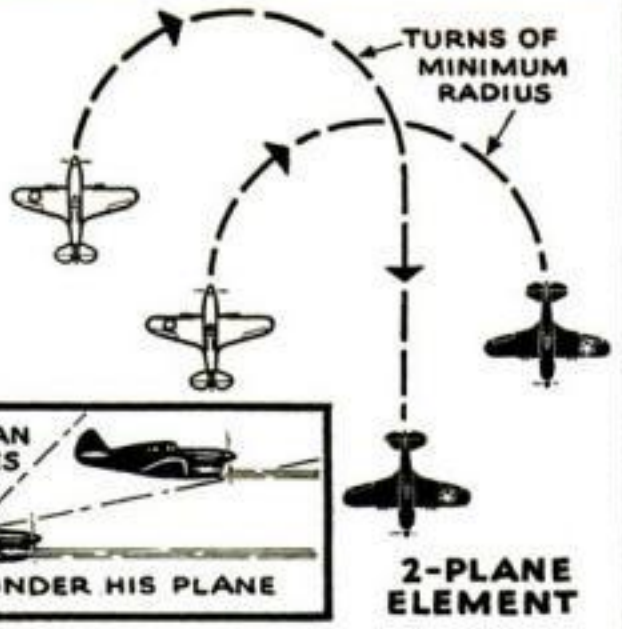
Defensive: How Fighters

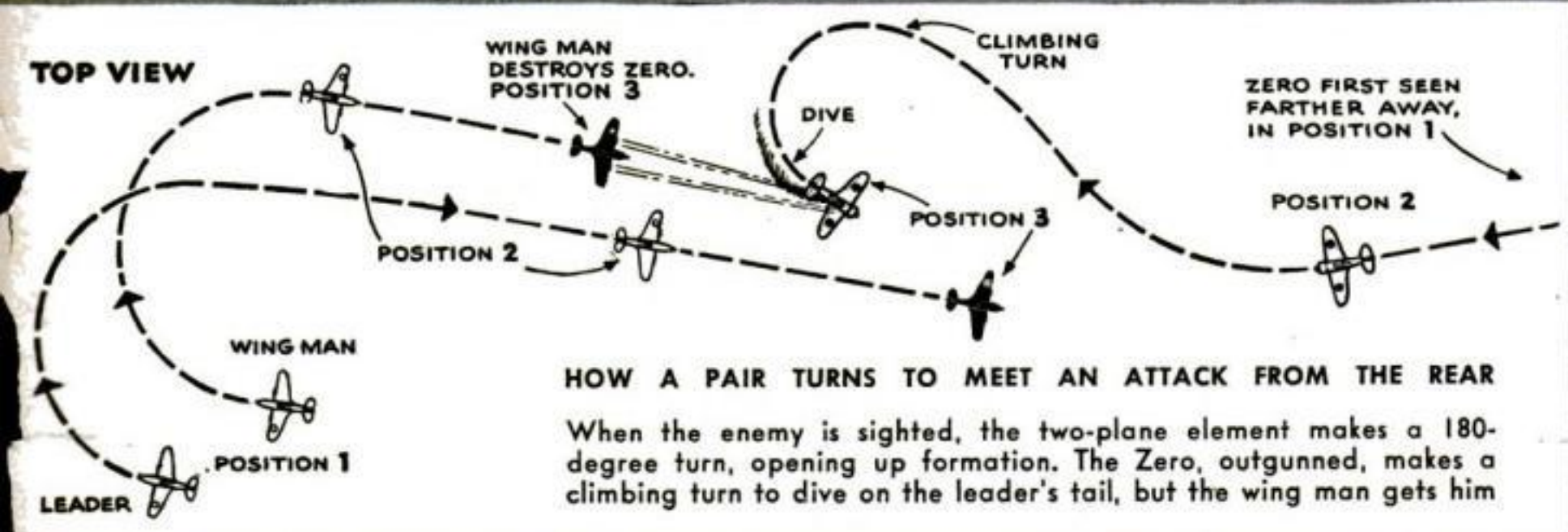
TACTICS



WHY THREE-PLANE ELEMENT WAS REPLACED BY TWO-PLANE "PAIR"

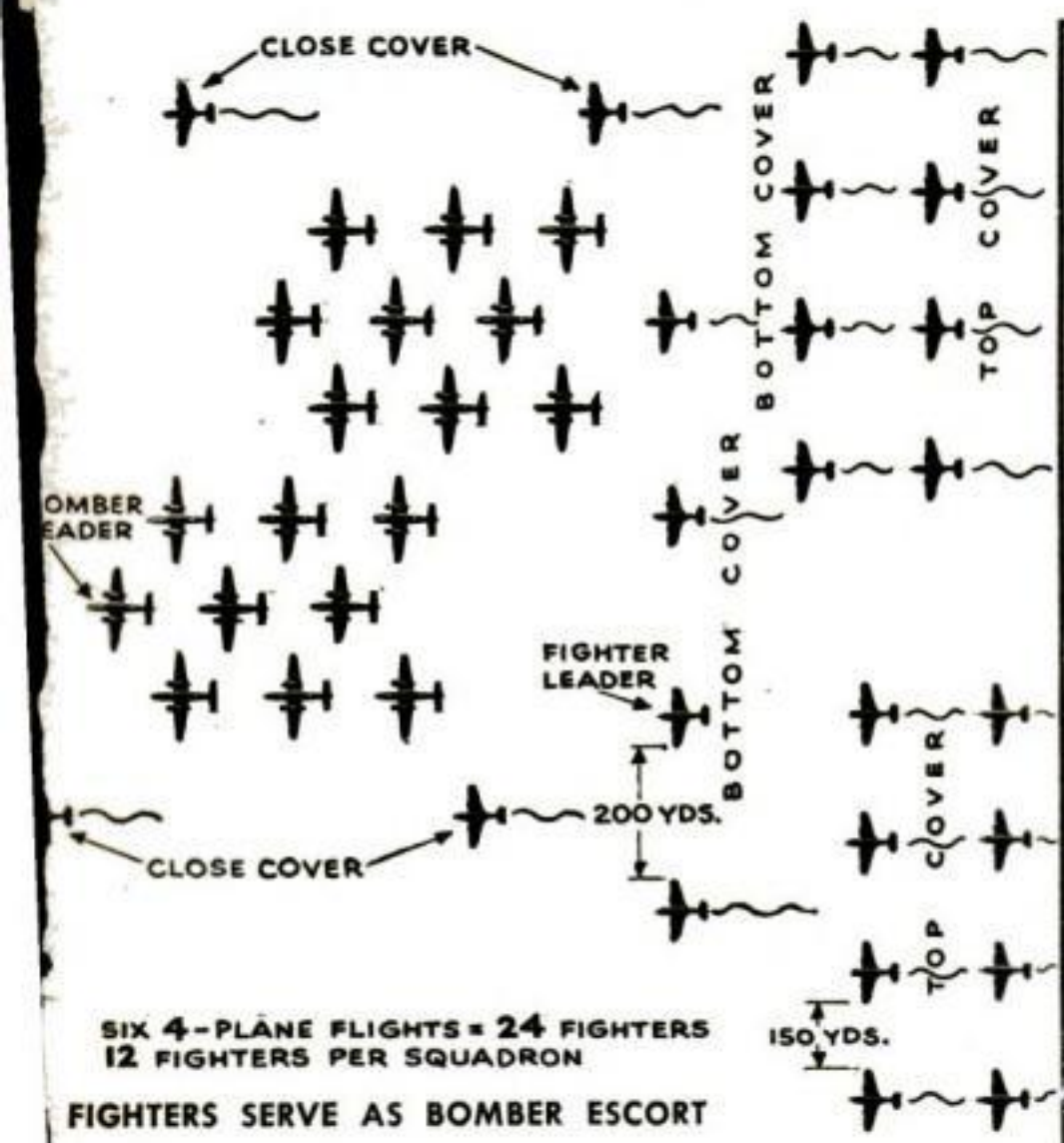
Quick turns mean life or death in air combat. Two planes maneuver more easily and safely together than three



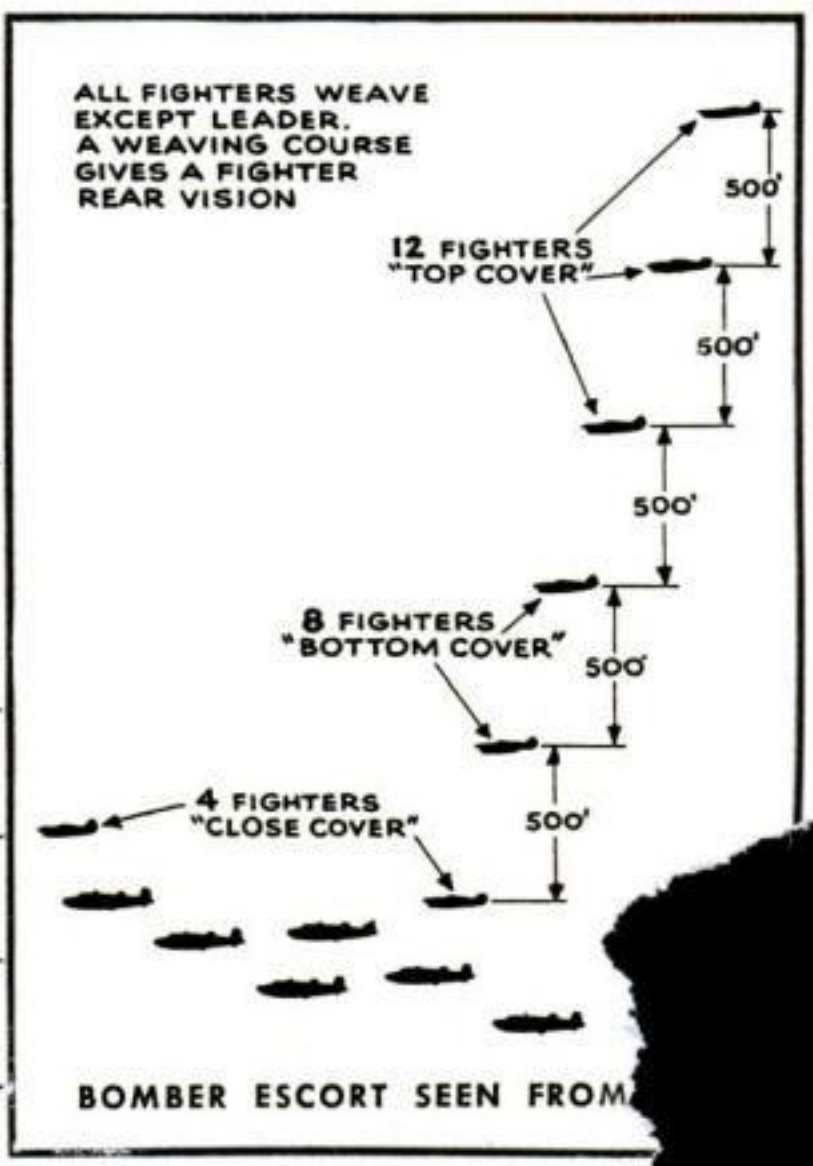


HOW A PAIR TURNS TO MEET AN ATTACK FROM THE REAR

When the enemy is sighted, the two-plane element makes a 180-degree turn, opening up formation. The Zero, outgunned, makes a climbing turn to dive on the leader's tail, but the wing man gets him



FIGHTERS SERVE AS BOMBER ESCORT

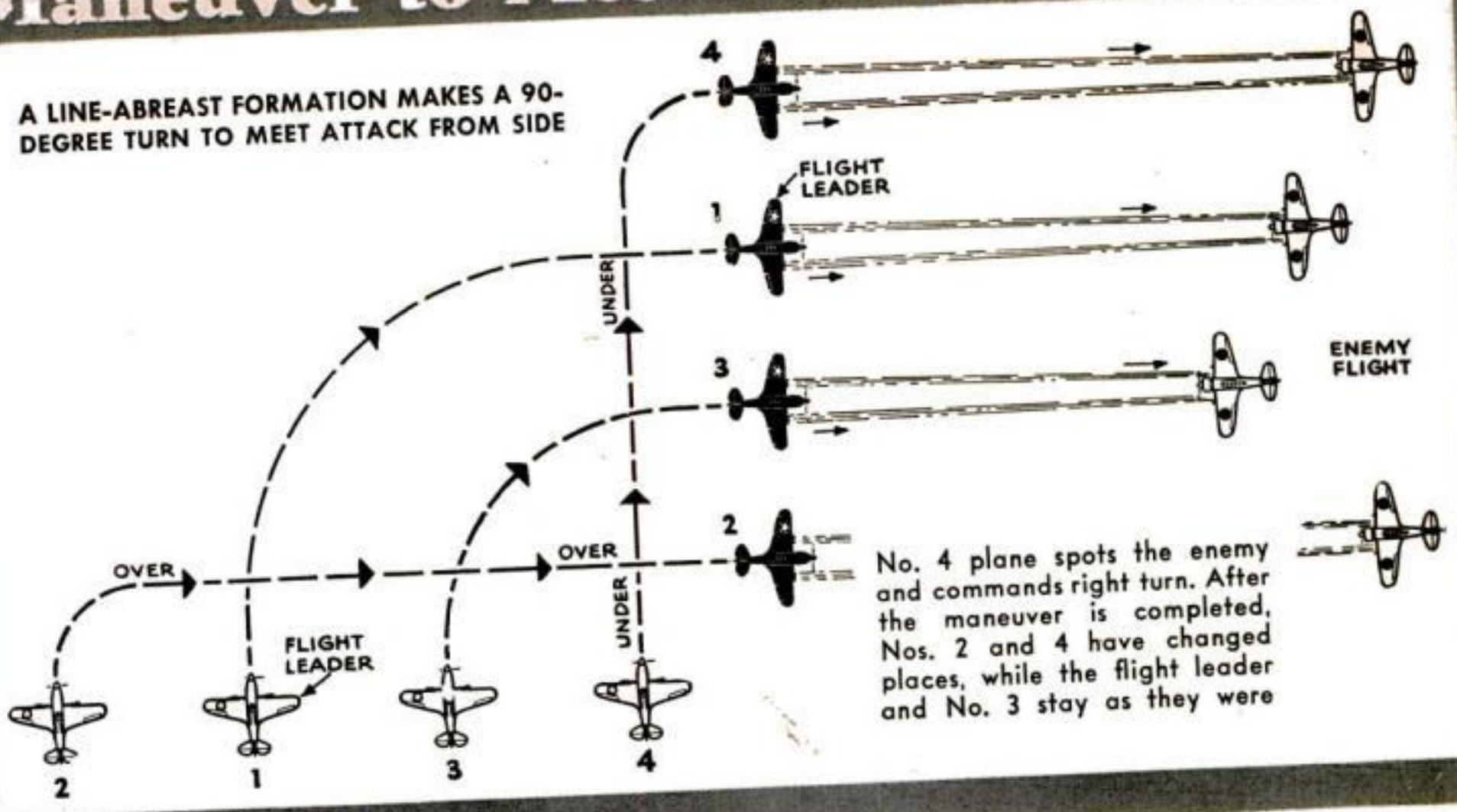


BOMBER ESCORT SEEN FROM

Heavily loaded bombers are not easily maneuvered, and need fighter escort to protect them from enemy interceptors. The protective scre n must be disposed so as to meet any likely attack. A good arrangement is shown above. Attacking planes will be sure to find plenty of fighters before they can close on the bombers to Fighter-bombers do not need escort, since can jettison their bombs and protect thems from enemy fighters if they get in a tight s

Maneuver to Meet Attack

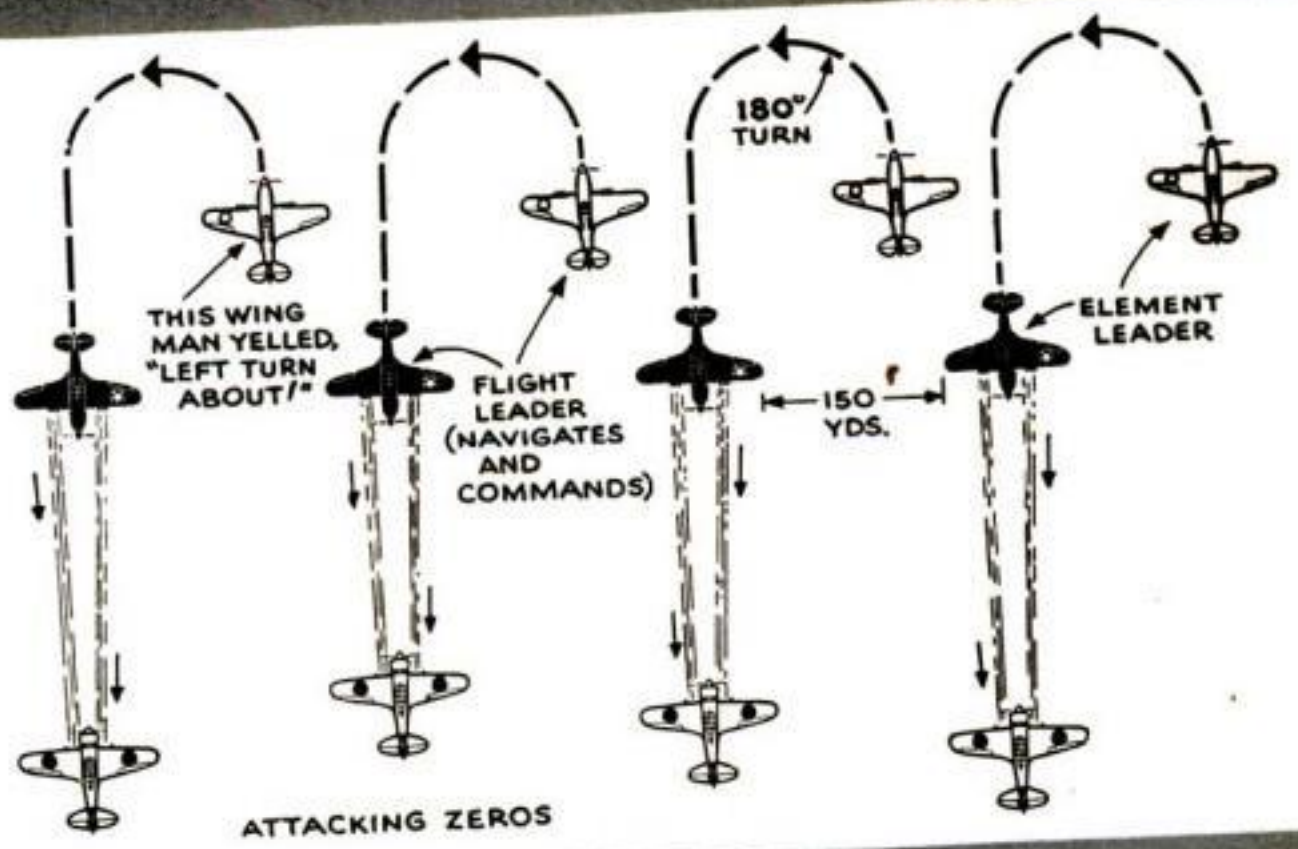
A LINE-ABREAST FORMATION MAKES A 90-DEGREE TURN TO MEET ATTACK FROM SIDE



No. 4 plane spots the enemy and commands right turn. After the maneuver is completed, Nos. 2 and 4 have changed places, while the flight leader and No. 3 stay as they were

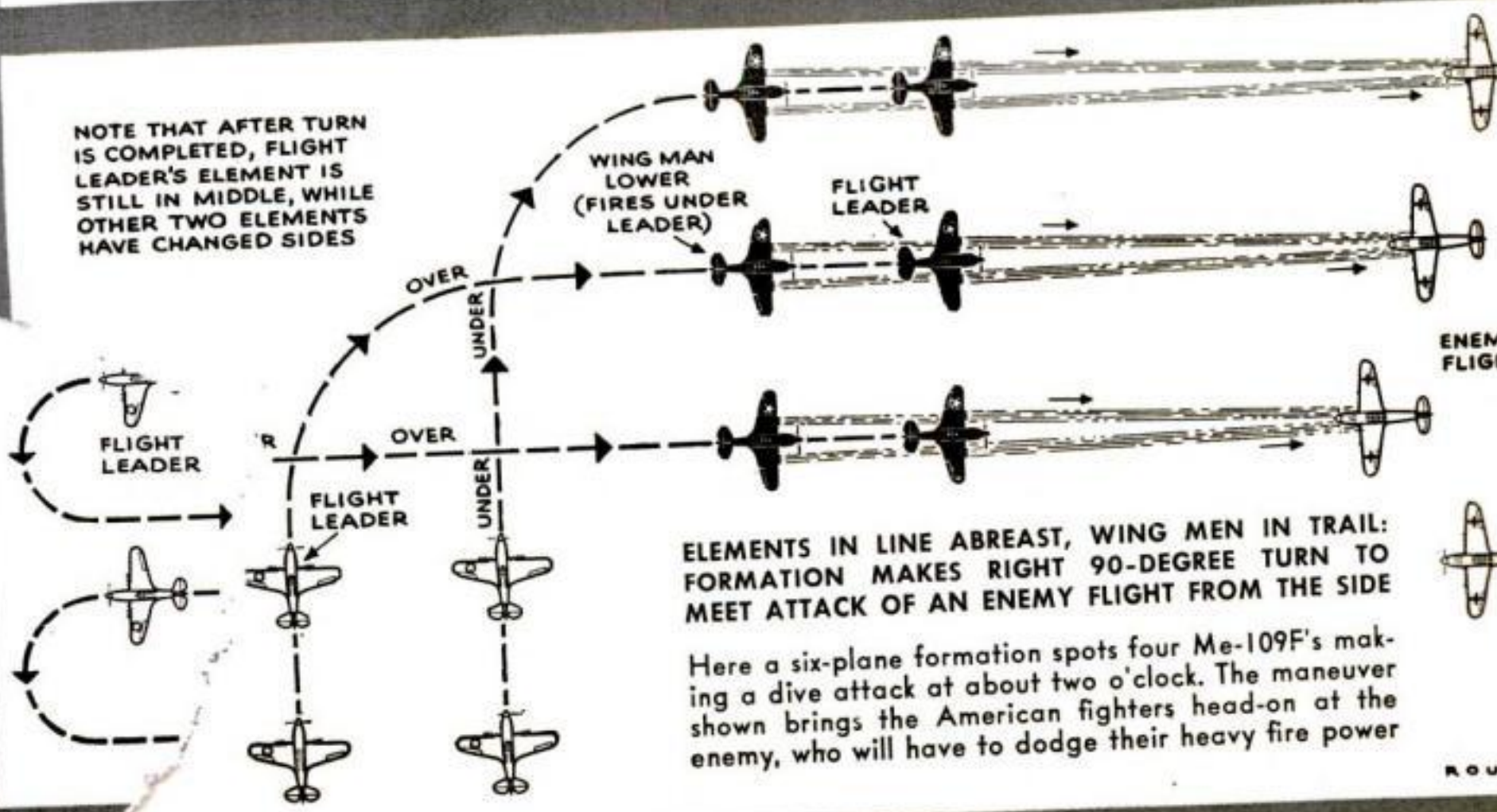
LINE-ABREAST FORMATION IS ATTACKED FROM REAR

One of the wing men of the four-plane formation sees a flight of Zeros diving from the rear and shouts "Left turn about!" into his radio. Each plane makes a sharp 180-degree turn to meet the enemy head-on. Any pilot who sights the enemy can give the necessary command. This formation is especially good for low-altitude sweeps over enemy territory where attack is likely to come from rear. Each man looks for trouble over his companions' tails



ATTACKING ZEROS

NOTE THAT AFTER TURN IS COMPLETED, FLIGHT LEADER'S ELEMENT IS STILL IN MIDDLE, WHILE OTHER TWO ELEMENTS HAVE CHANGED SIDES



ELEMENTS IN LINE ABREAST, WING MEN IN TRAIL: FORMATION MAKES RIGHT 90-DEGREE TURN TO MEET ATTACK OF AN ENEMY FLIGHT FROM THE SIDE

Here a six-plane formation spots four Me-109F's making a dive attack at about two o'clock. The maneuver shown brings the American fighters head-on at the enemy, who will have to dodge their heavy fire power

ROUSE

FIGHTER TACTICS

Offensive! Carrying the

FRONT-QUARTER ATTACK

A P-40 fighter dives from above the right front quarter of a formation of Junkers Ju-88 bombers, goes deep below the enemy, then climbs to put a burst into the left rear plane. Recovers for the next attack

FRONTAL ATTACK FROM ABOVE

Four fighters drop out of the sun onto a three-plane element, pass just in front of the bombers. They recover down, out, and up for another pass from the rear quarter

GOOD

S ANGLE OF ATTACK IS GOOD BECAUSE FIGHTER
Y FACES SIDE FIREPOWER OF ONE BOMBER

BAD

MBERS HAVE
DENLY SHIFTED
MATION SO ALL
FIRE AT FIGHTER, MAKING
GINAL ATTACK FOOLHARDY,
HTER MUST MAKE ATTACK
SAFER ANGLE

PREFERABLE

ATTACK FROM SIDE IS BETTER THAN FROM REAR

Here a pair of P-40's, attacking three Heinkel He-111K's from the side, are exposed only to the fire from a top and bottom gun of the nearest plane. The fighters tackling the bombers from behind have easier shooting, but are themselves afire from the enemy's concentrated fire power

Ball Against the Enemy

FRONTAL ATTACK FROM BELOW

Diving below the front of an element of Dornier Do-17's, two fighters climb to give the leader and right wing ship a lusty burst. Then they dive down, out, and up to make another pass

ATTACK FROM BELOW

A P-40 dives to gather terrific speed, then flies up almost vertically to let fly a burst of fire under one of the bombers. He must fall out to one side to avoid being caught in the murderous fire in the formation's trail

REAR-QUARTER ATTACK

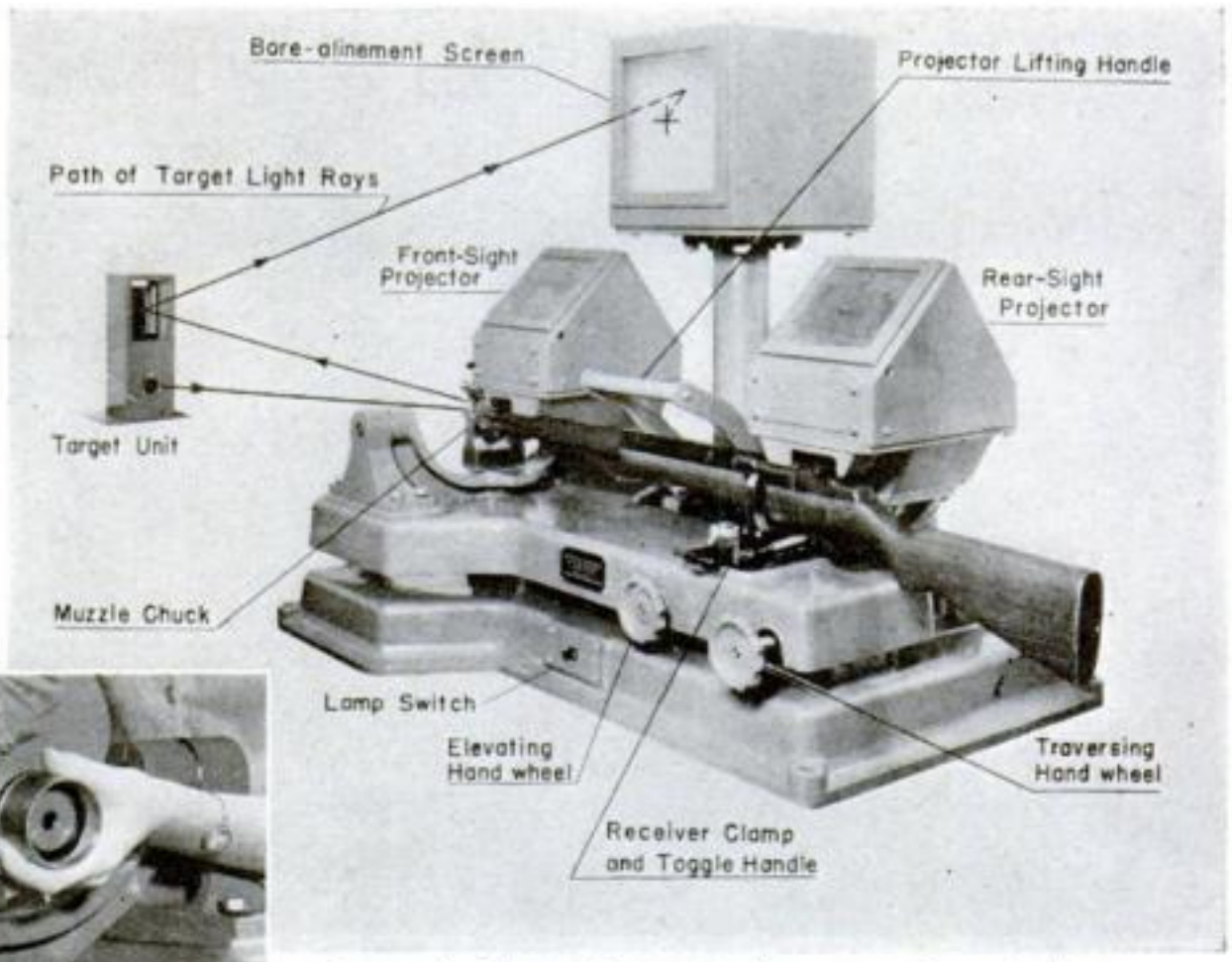
From the left rear quarter of an element of Do-17's, a fighter dives below the bombers, then climbs to put a burst into the left rear ship. In offensive tactics, orders always are to "pick one target and stick to it"

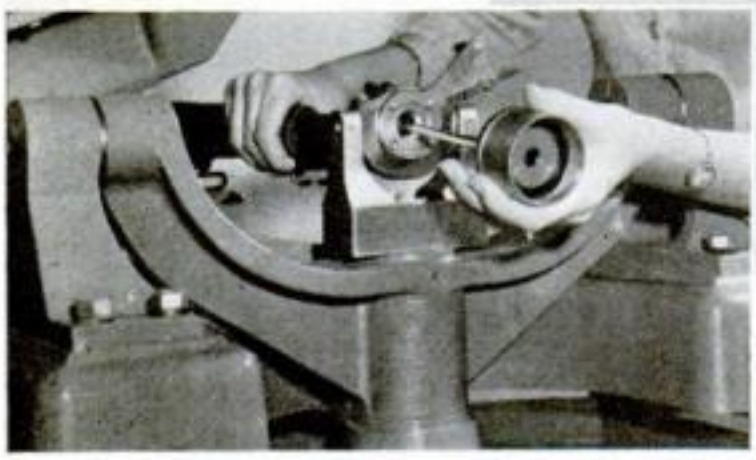
BOMBING RUN TO AVOID AA FIRE

When acting offensively as fighter-bombers, single-seaters first seemingly fly past the target, then turn and take serpentine courses to dodge flak. When over the target, they drop bombs. In this drawing, distances are greatly reduced for diagrammatic purposes

STEWART ROUS

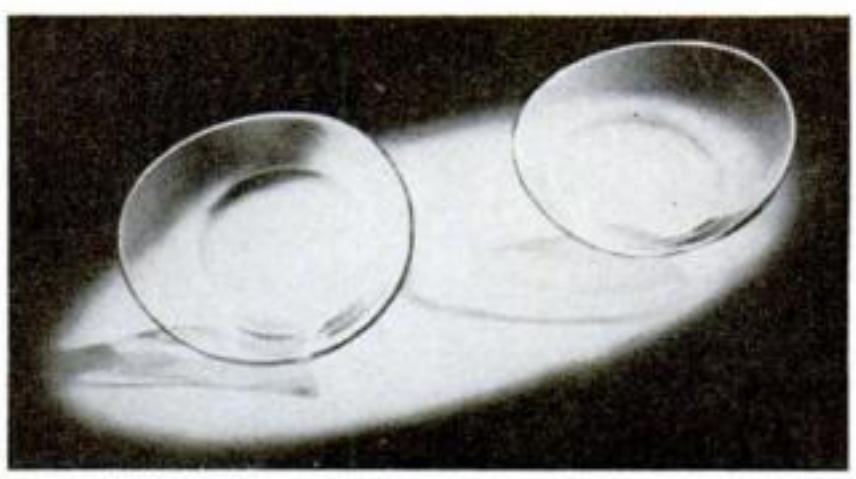
PRECISION SIGHTING of Garand rifles is now done with mirrors and without firing a shot, by duplicating the sight setting of a master rifle. In an optical gauge designed by General Electric, a mirror inserted in the rifle barrel "fires" a cross of light at a mirror target, and the ray, reflected to a third mirror, is thrown onto a ground-glass screen that bears a master cross. Superimposing this image on the master cross correctly positions the rifle; and the sights, magnified on overhead projectors, are adjusted accordingly. The gauge cuts sighting time to two minutes, saves ammunition, and works in a fraction of the space needed for setting sights by actual firing.

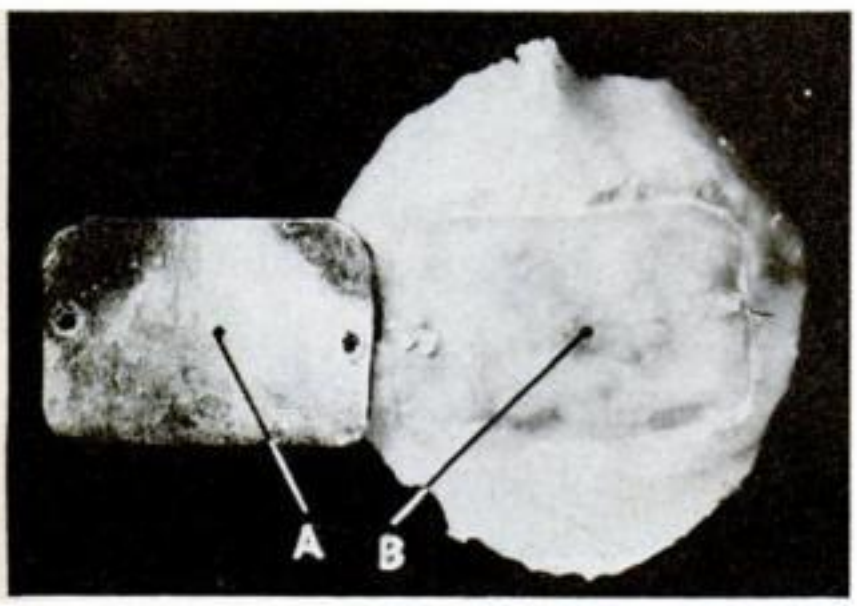




General Electric's optical gauge for sighting Garand rifles, showing the path of the target light rays, and projectors that magnify sights. Left, inserting mirror-fitted plug in the muzzle

PLASTIC OPTICAL LENSES of the contact type, made by Du Pont, weigh about 40 percent as much as those of glass, are unbreakable, and are virtually invisible. Worn next to the eyeball and held in position by the lower and upper eyelids, lenses of this kind are in use by about 5,000 people, including actors and athletes, although it is said that they could very well be used by at least 85 percent of those persons who are now suffering from defective vision.

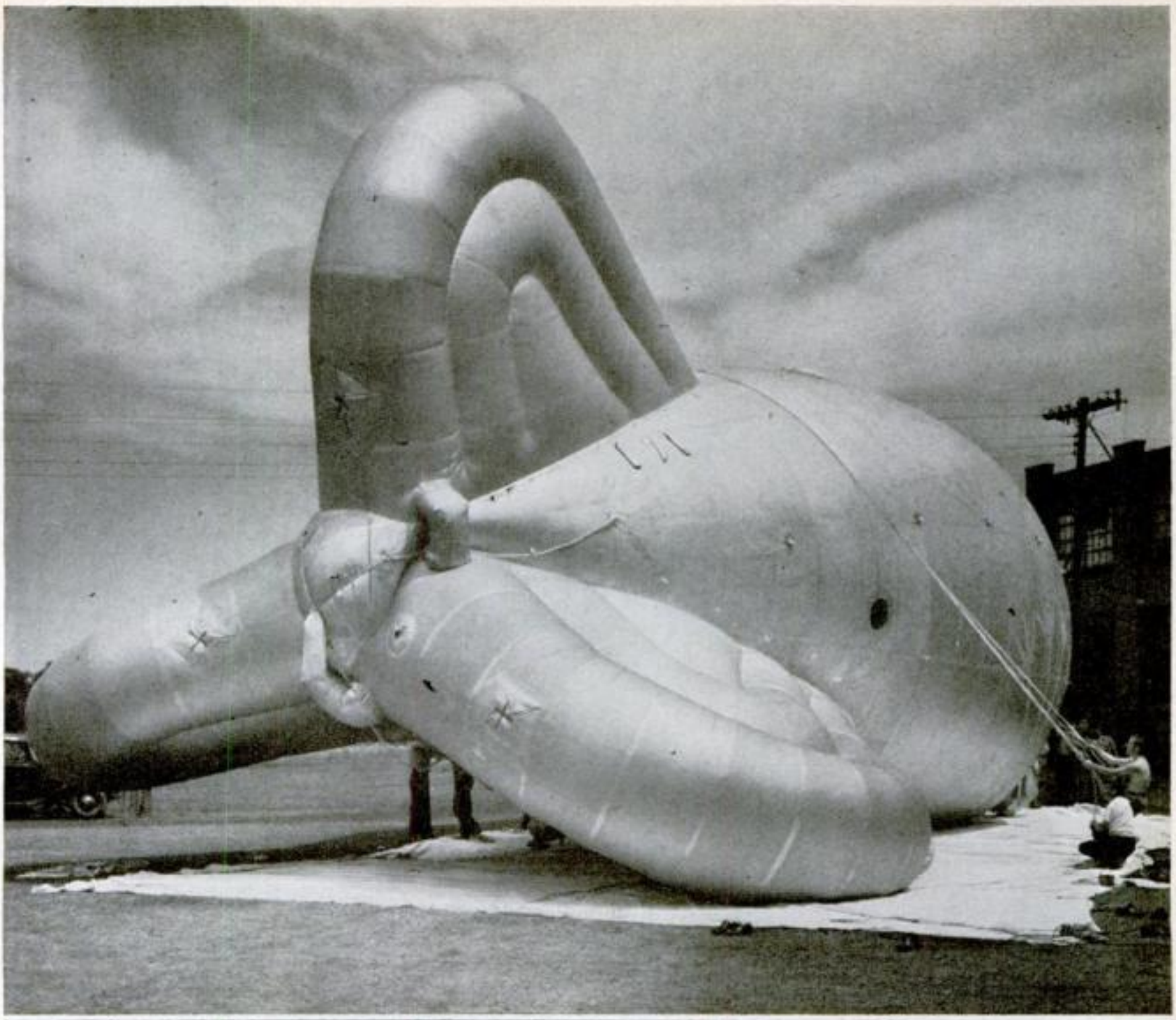




Journal of American Medical Association

Tantalum plate (A) swung away from cat's skull (B) shows no ill effects on the tissues after six months

CUSTOM-MADE SKULL PLATES made from tantalum, a rare metal, can be molded into shape right at the operating table without the use of heat, according to Lieut. Robert H. Pudenz, U. S. Navy Medical Corps. Using heavy surgical scissors, a rawhide mallet, and a wooden mold, a surgeon repairing a cranial injury can cut and hammer this ductile metal into the exact contours required. A blue-white, steel-like cousin of vanadium, tantalum (so called because it is difficult to isolate) is a good bone-replacement material on all counts, for it is nonpoisonous and nonabsorbable, does not cause any adverse reaction of the body tissues, and, although heavy, can be cut so thin that its weight is not oppressive.



Helium-filled barrage balloons, like the one above, trail steel cables to protect cities and ships from planes

AMERICA HAS A CORNER ON BALLOON JUICE

Rare helium, produced only in this country, has many wartime uses.

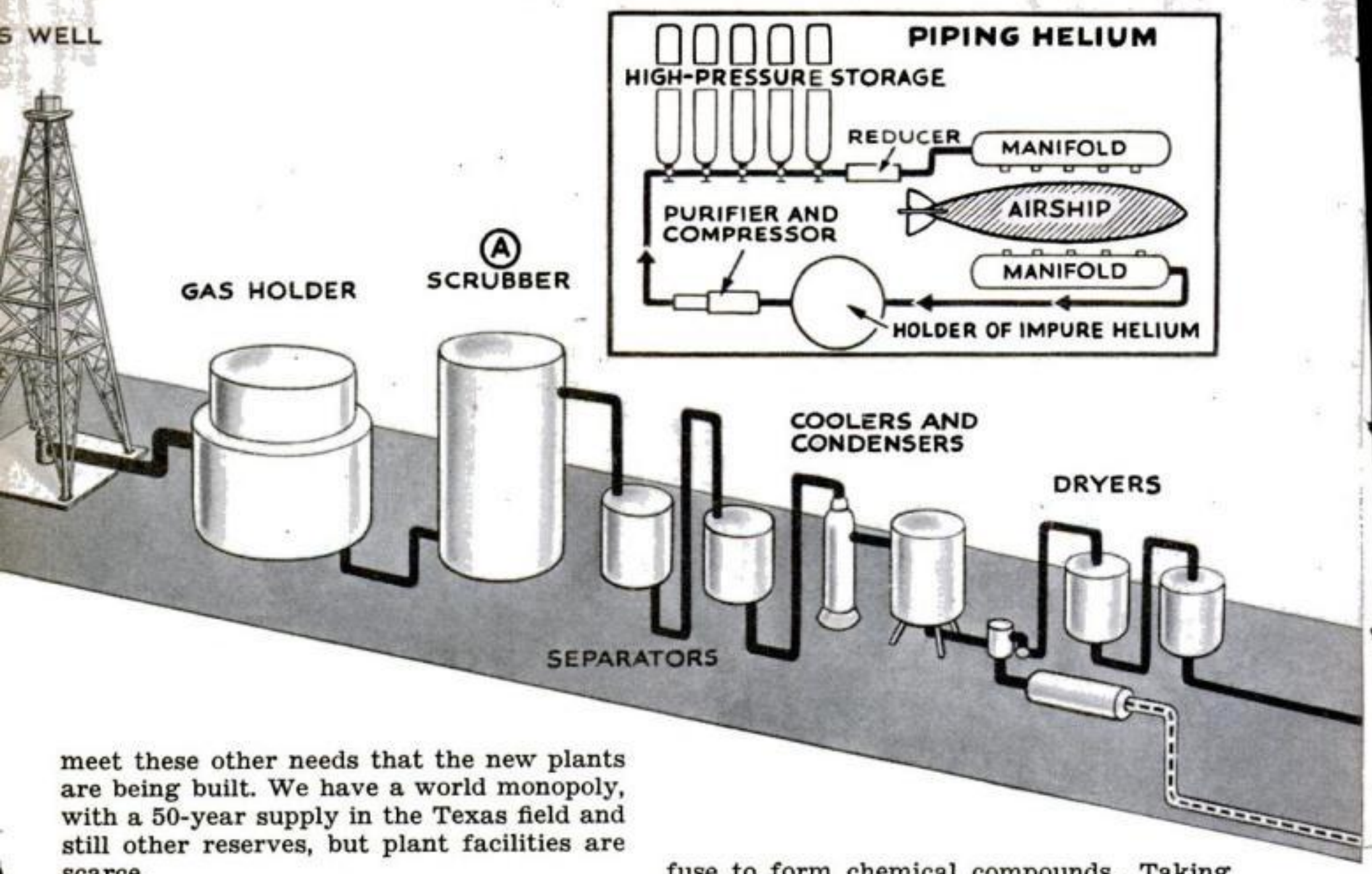
By JEAN ACKERMANN

THREE years ago our helium plant in Texas—the only one in the world—operated comfortably at less than half its capacity. Today, enlarged, it is steaming ahead at top speed, while a second unit installed by the Bureau of Mines has already made shipments. ...ants are under construc- ...e production rate up to ...war figure.

...r the increased demand ... raising of the Navy's ...m 23 to 151 ships— ...tire number built from ...a 1941.

...ough aircraft use is still its star ...le, helium has branched out with marked success in medical, industrial, meteorological and nonflying military uses. And, since aircraft took all our '41-'42 helium production, it is partly to

HOW HELIUM IS PRODUCED...AND USED



meet these other needs that the new plants are being built. We have a world monopoly, with a 50-year supply in the Texas field and still other reserves, but plant facilities are scarce.

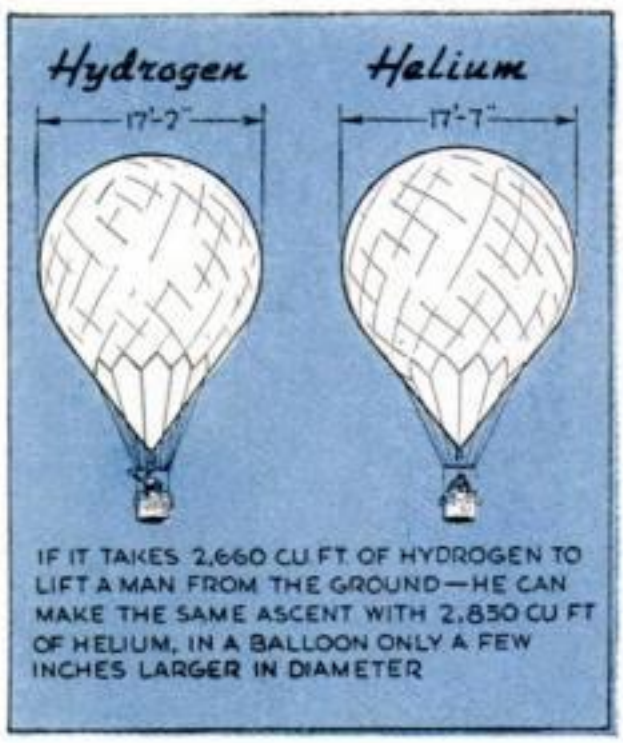
Today, in your community hospital, an asthma or cardiac patient may be finding relief through inhaling "made-to-order air" —79 percent helium and 21 percent oxygen— for fast-diffusing helium flows readily into constricted respiratory passages that will not admit natural nitrogen-and-oxygen air. In the operating room, helium readily dilutes anesthetic gases to make them non-explosive.

Since helium does not dissolve in the blood, the Navy supplies its divers with helium air so they may reach greater depths and come up faster without danger of the dreaded "bends" caused by bubbles of nitrogen gas.

Sandhogs who tunnel at more than normal atmospheric pressure breathe helium air for this and for related reasons. Blockage of ear, nose, or sinus may be caused by failure to equalize inner and outer pressure. This is relieved by helium, which flows quickly into air passages and equalizes pressure. Pilots are given the same treatment after rapid descents.

Helium belongs to the family of "noble" gases— so termed because they refuse to form chemical compounds. Taking advantage of its aloofness, industry finds helium an excellent storage medium for easily decomposed phosphorus and potassium. It will not react with them, and it excludes air. Workmen now also handle molten metal in an atmosphere of helium to reduce corrosion and gas bubbles, for, next to neon, helium is the least soluble gas.

As late as last year, featherweight magnesium metal could not be welded because it caught fire so easily. Now a blanket of helium protects it from oxidation during arc welding, permitting workers to form it into weight-saving wings and fuselages for warplanes. Its marked ability to carry off heat also recommends helium for this application.

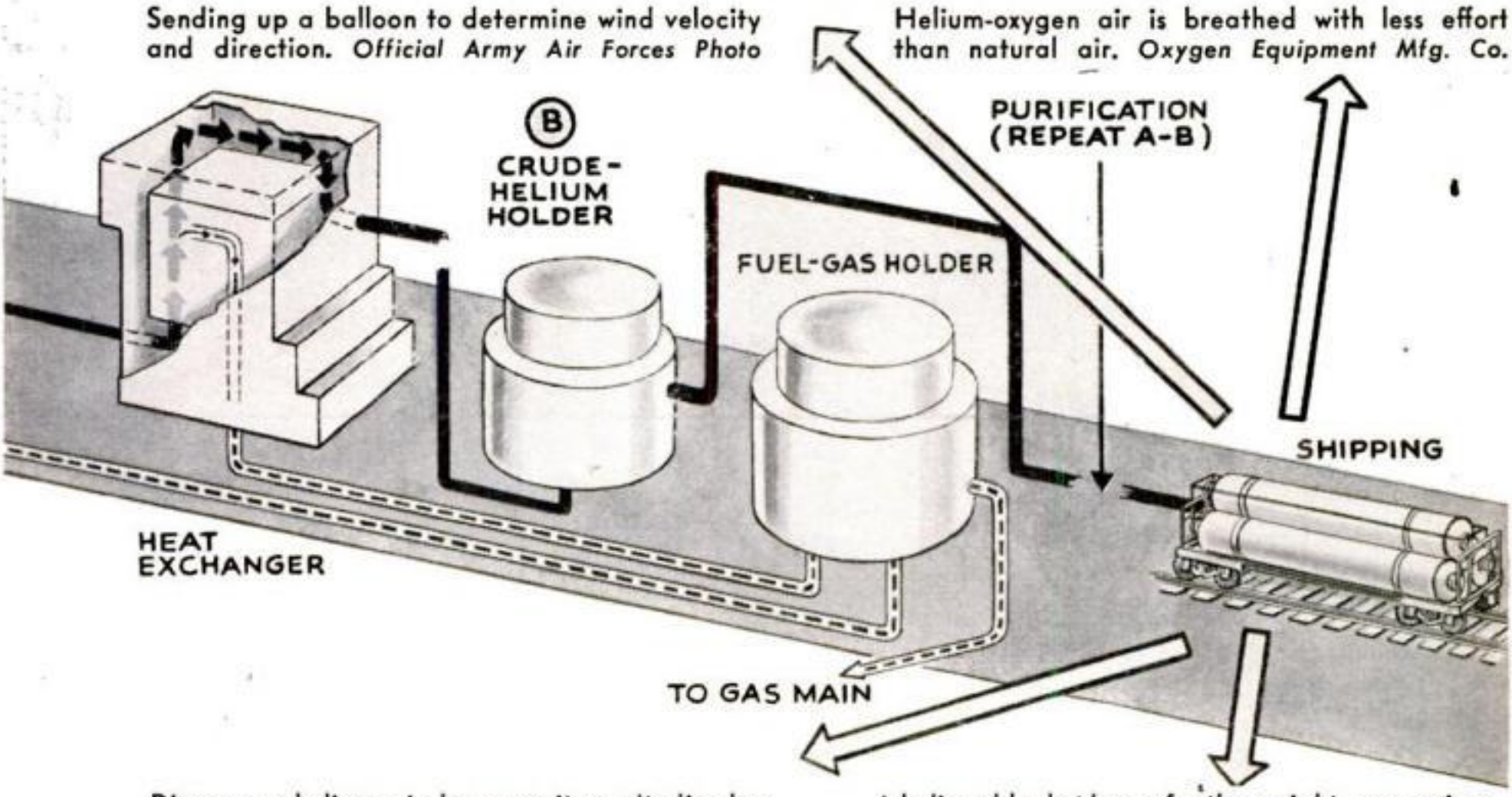


By far the most useful property of helium, its lightness, makes it almost ideal for inflating balloons and aircraft of every description. Its buoyancy is 93 percent of that of inflammable hydrogen, the only lighter gas. If it took a spherical balloon containing 2,660 cubic feet of hydrogen (making it about 17 feet in diameter) to lift a man from the ground, the balloon need be en-

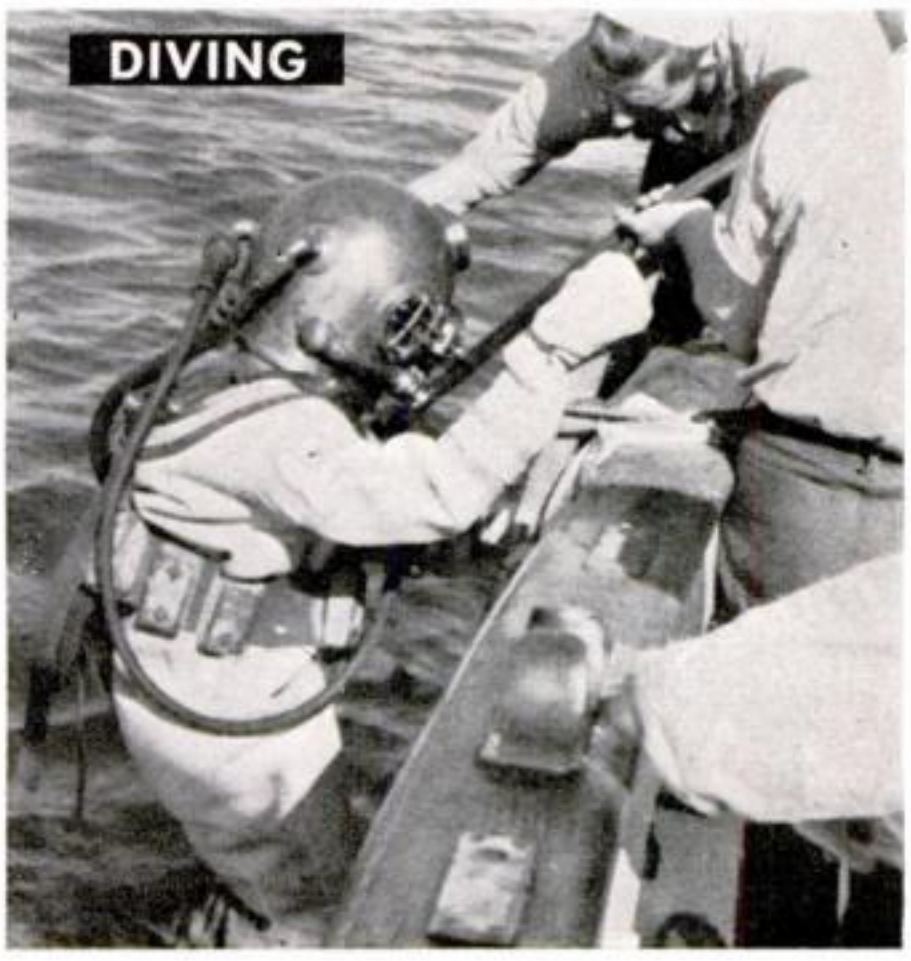
(Continued on page 202)

Sending up a balloon to determine wind velocity and direction. *Official Army Air Forces Photo*

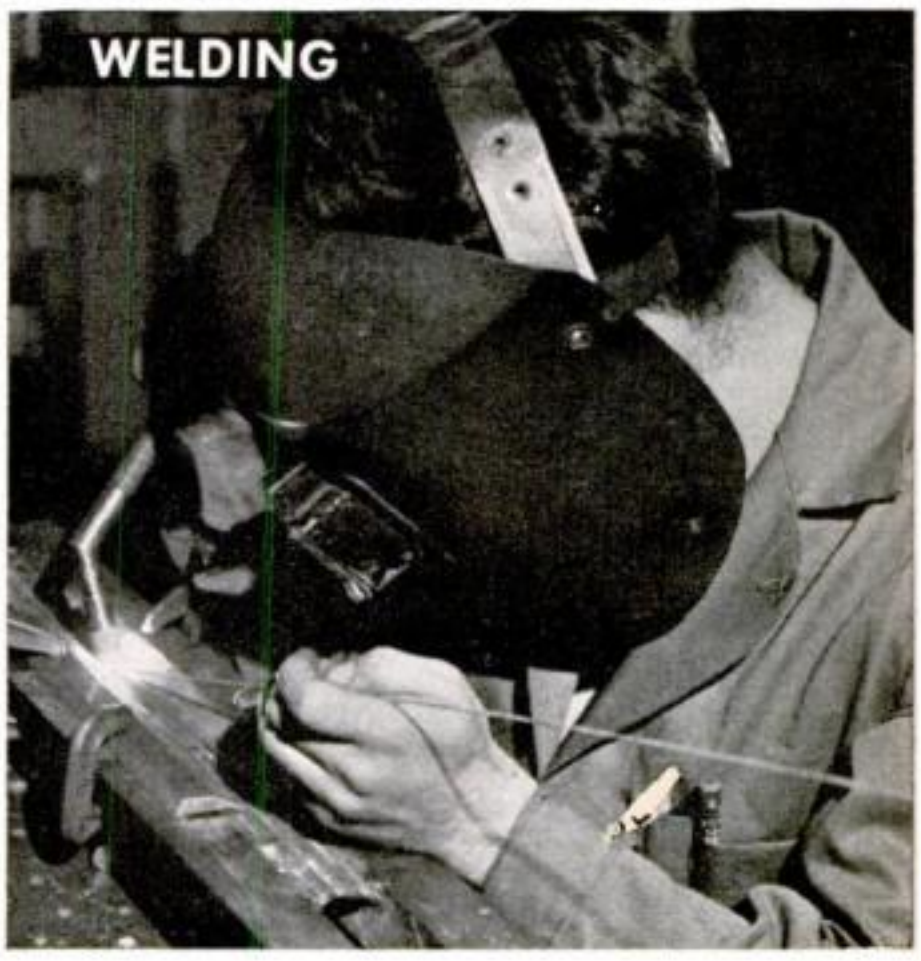
Helium-oxygen air is breathed with less effort than natural air. *Oxygen Equipment Mfg. Co.*



Divers use helium air because it won't dissolve in the blood and cause "bends." *U.S. Navy Photo*



A helium blanket keeps featherweight magnesium metal from bursting into flame during arc welding

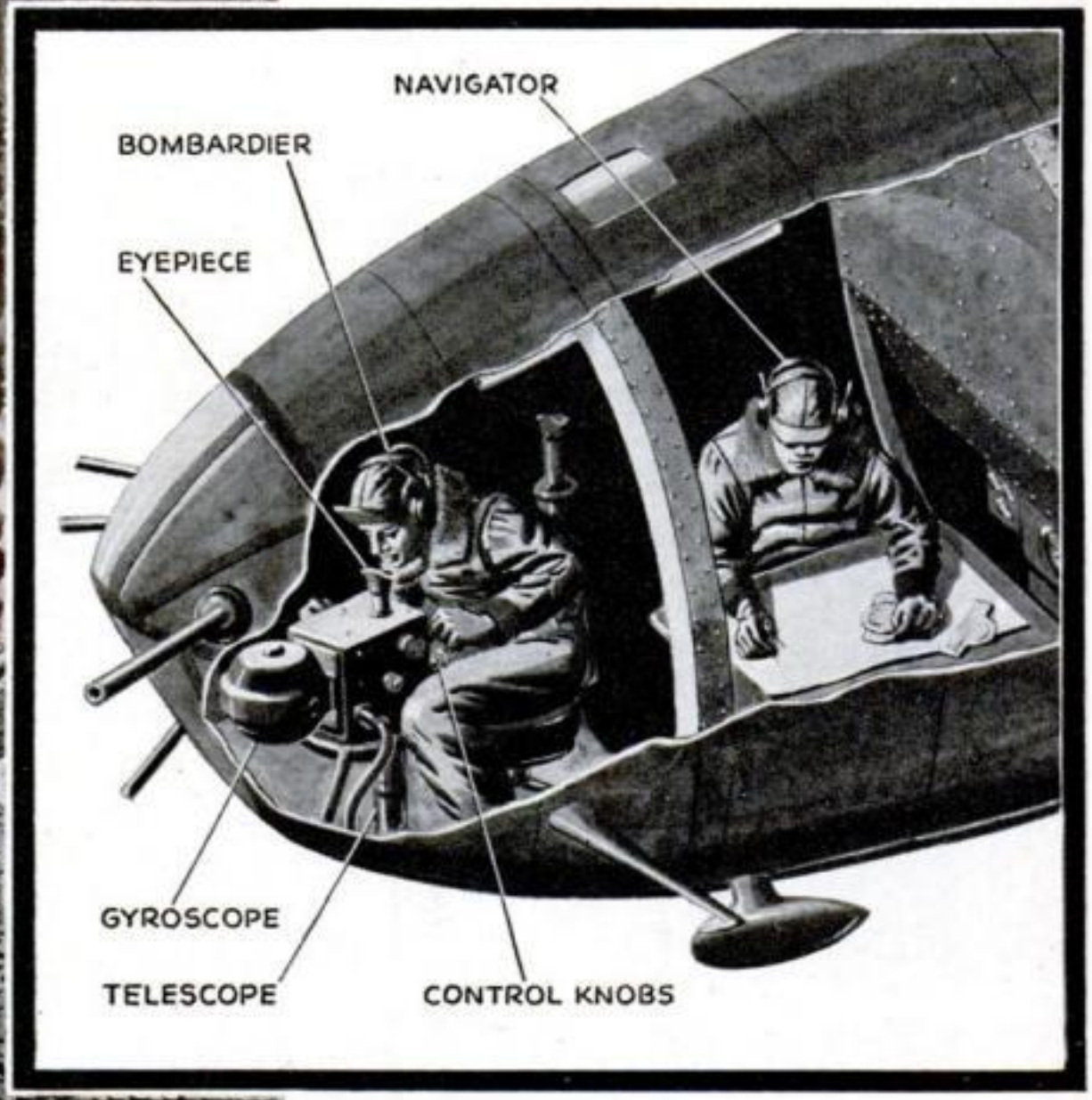


What

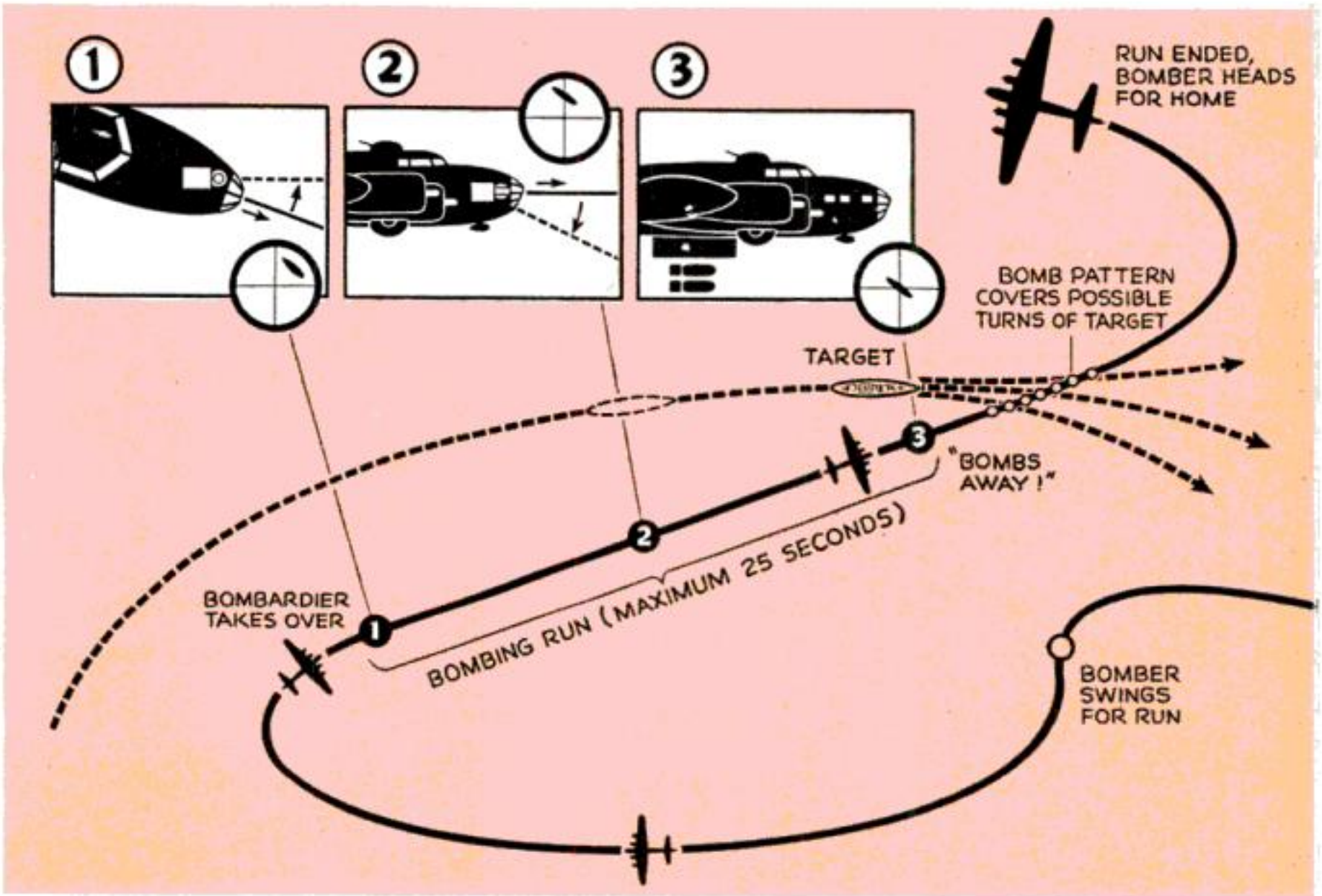
AMERICA'S famous Norden bombsight—the ultra-secret device which inspired our airmen's proud boast that they could "drop a bomb in a pickle barrel"—has now been disclosed as a complex arrangement of lenses, gyroscopes, and electrical connections which make mathematical corrections for every factor involved in the launching of a bomb at a target, and even control the operations of the plane at the crucial moment of bomb release.

The veil of secrecy over the Norden sight was lifted recently in a distinctly discreet and limited manner, mainly because military authorities were certain that some of the instruments had been captured by the enemy as an unavoidable

During the "run," bombardier takes command, tries to keep the run under 25 seconds. Longer runs give enemy too good a straight-moving target



Makes Our Bombsight So Deadly?



1 Locating target in quadrant, the bombardier fixes sight for wind, speed, drift, then sets target on vertical hair line, which automatically lines up the plane's approach

2 With plane now properly aimed and flying on a level, bombardier brings target to horizontal hair line to fix trajectory of bombs at time of release

3 Target is held automatically at intersection of the hairs until the prearranged instant when the bombs will be released, and the run terminated

incident of large-scale warfare. Even so, the secret remains safe for all practical purposes. Because of its extreme complexity and precision of manufacture, it would take the enemy years to mass-produce the sight and train bombardiers in its use.

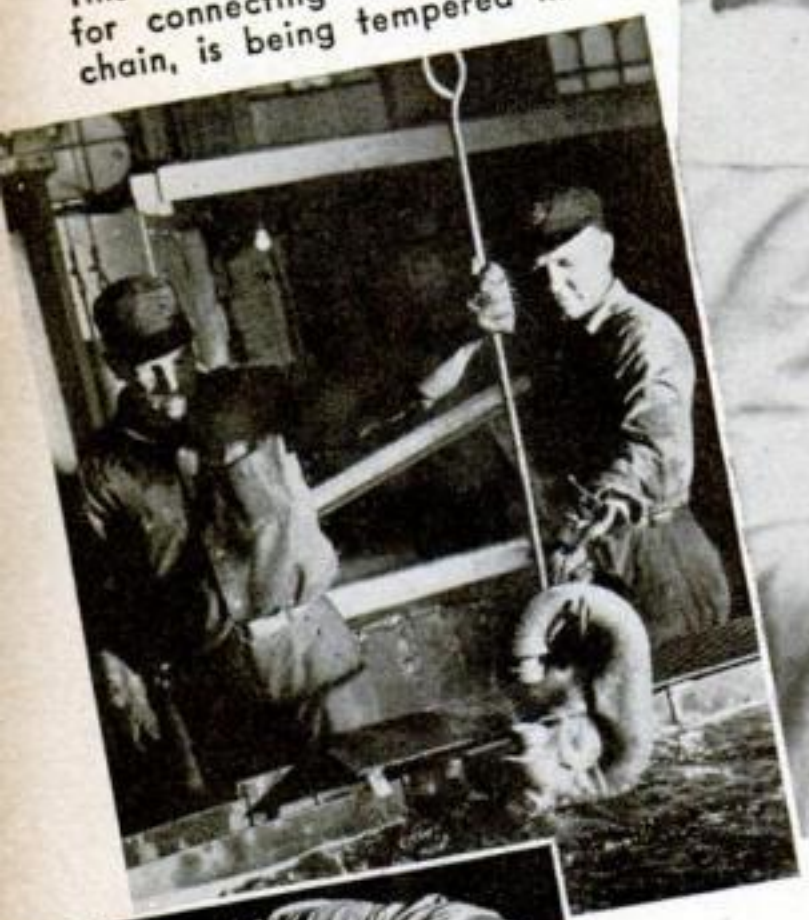
The bombsight normally is mounted in the plane's nose, behind a special panel of thick protective glass. It consists of three elements encased in black metal. One element, containing the sighting telescope and adjusting controls, is at the bombardier's right; the second, containing the gyroscope, is at his left, and the third is below the gyro.

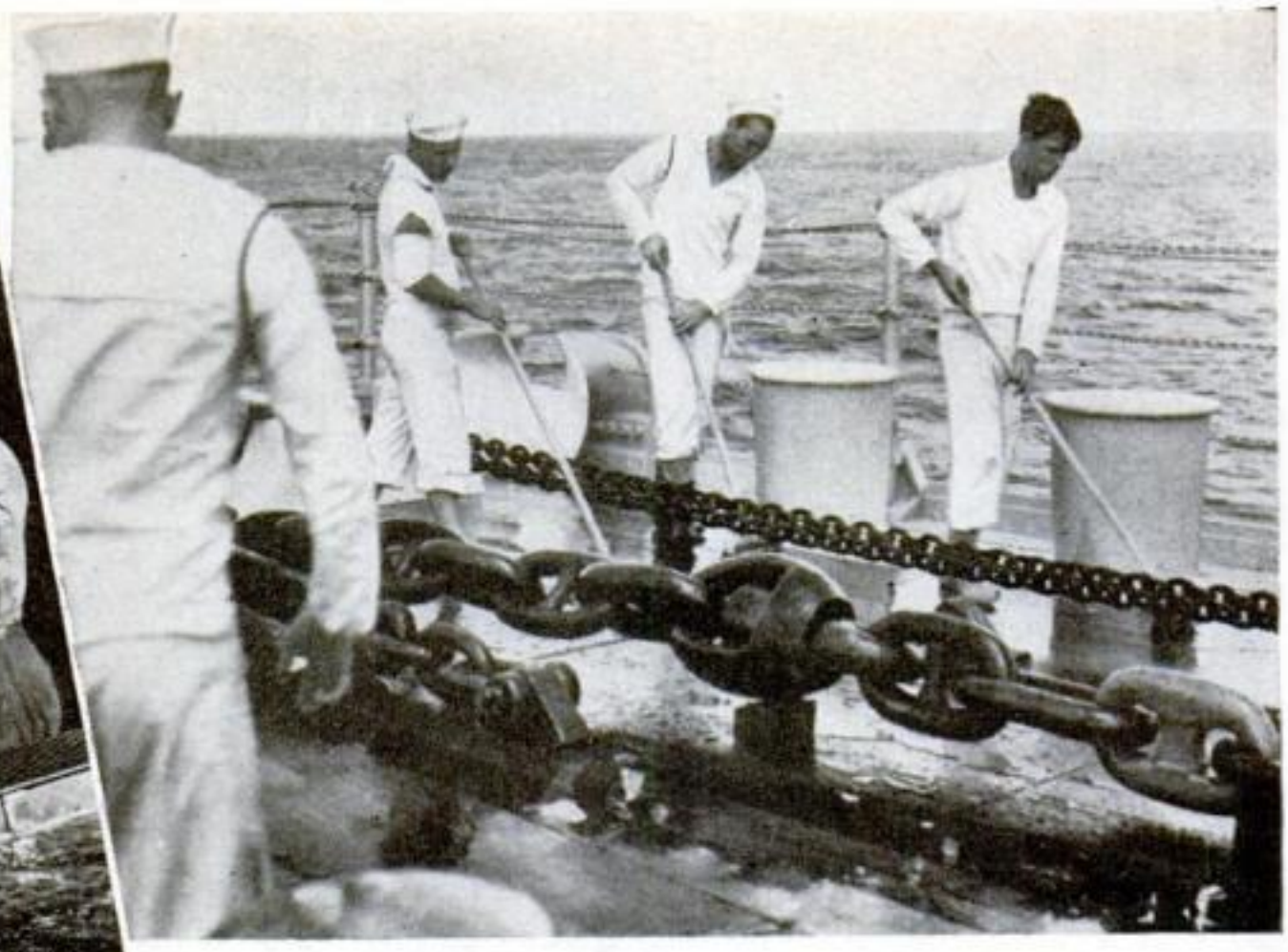
This is a generalized description of how the sight is used: Before beginning the "run" on the target, the bombardier adjusts the sight for the chosen altitude and speed of the plane, and sets the gyroscope spinning with its axis perpendicular to the ground. He then lines up the sight with the plane's actual direction and arms the bombs preparatory to dropping them.

The run itself lasts up to 25 seconds—more than that gives the enemy flak too good a straight-moving target—and during that time the bombardier is in effective command of the ship. Sighting down through the telescope, he proceeds to line up two cross hairs to intersect on his target. This is accomplished by highly skillful manipulation of four knobs, two of which bring the telescope to bear on the target, while the others correct the plane's course to coincide with that bearing.

The sight does the rest, automatically keeping the plane in such position that the cross hairs remain on the target. When the bombardier calls "Bombs away!" his job is done, and the pilot takes over again.

This red-hot metal piece, used for connecting two lengths of chain, is being tempered in oil





Big or small, every chain must hold fast, for one weak link can imperil both the ship and the lives of hundreds of men

Navy Speeds Up Chain Making

A DIE-LOCK method of making links, developed at the Boston Navy Yard's famous chain shop, is now providing our big fighting ships with the strongest anchor chains in the world. Until recently, a chain was assembled by heating open links and pounding them into locked position with giant steam hammers. Under the new method, in which links 50 percent stronger are being made 20 times faster, straight steel bars are bent and processed into two half links, one of which has threads that lock into the hollow parts of its complement. In the average battleship anchor chain, each steel link is 3⅜ inches thick and 20 inches long, weighs 129 pounds, and is break-strength tested at a million and a quarter pounds.

Photographs by George Woodruff

Threaded half of the new link (upper left) locks in hollows of other half

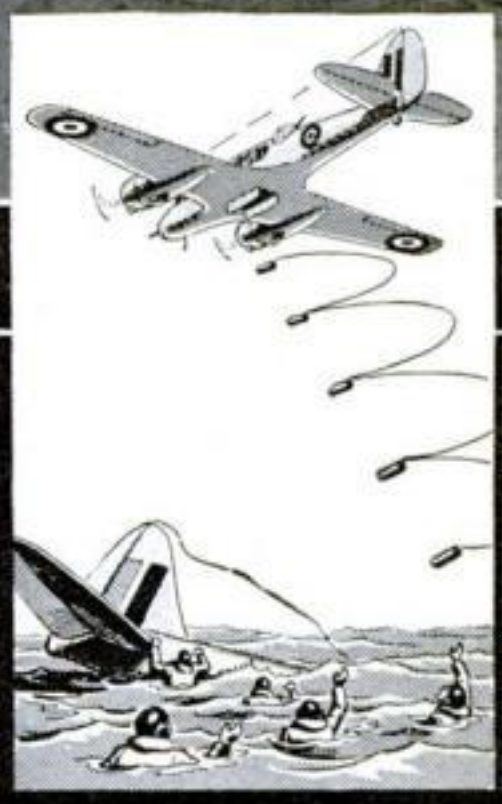
This chain is being made ready for testing at a strain that is far above its regular sea-duty load

A long gauge (above) is used to measure the big links while they are being strain-tested

In this giant press, equipped with small knives, excess metal and burrs are trimmed off from the surfaces of the links

RESCUE KITS DROPPED LIKE BOMBS

FOOD, warm clothing, comforts, and signals in plywood cylinders are now dropped like a stick of bombs by the Royal Canadian Air Force to aid shipwrecked sailors and cracked-up aviators. With a folded eight-man rubber dinghy in the center, connected by means of a kapok rope to the other containers, the Lindholme rescue gear, as it is known, is dropped accurately from the bomb racks of a plane. The dinghy inflates on contact with the water; men climb in and haul in the packs with the things they need while awaiting rescue.



THEY BAGGED 93 JAP PLANES IN NINE WEEKS!

Tojo

Navy Fighter Squadron Five chalked up a high score in the early Solomons fighting. This is the story of the men and of the planes they flew.

By
ALLEN RAYMOND

•

FIGHTING Squadron Five, U.S.N., led by Lieutenant Commander Leroy C. Simpler, 37 years old, of Lewes, Del., brought down 77 Japanese planes, probably another 13, and contributed to the destruction of three more during the fighting in the Solomon Islands from August 7 to October 15, 1942.

In helping protect the landings of United States Marines on Guadalcanal, August 7 and 8, Fighting Five destroyed 13 enemy bombers, damaged two more bombers and two Zeros. On August 24, when the Japanese launched a determined attack on the island, Fighting Five destroyed 19 enemy planes, including 14 dive bombers. The remainder were destroyed in the 34 days

Meets a Wildcat

that the squadron was based on Guadalcanal.

For its performance in all this fighting, the squadron received the congratulations of Admiral William F. Halsey, Commander of the South Pacific Area, and its commander received the Distinguished Flying Cross and Navy Cross from Secretary of the Navy Frank Knox, on behalf of the President.

This squadron of fighting men flew an airplane known as the Wildcat, the product of the Grumman Aircraft Engineering Corporation, Bethpage, N. Y. The Grumman Wildcat has been the principal fighting plane for the U. S. Navy and Marine Corps since Pearl Harbor. The Grumman company has delivered more fighting planes to the Navy than any other manufacturer. For its services it has been cited by Rear Admiral John S. McCain, U. S. N., Chief of the Bureau of Aeronautics, as follows:

"The name 'Grumman' on a plane or a part has the same meaning to the Navy as the word 'Sterling' on silver."

Designated F4F4 by our Navy, the Wildcat is also supplied to the British Navy and is known in that service as the "Martlet." It is a single-engined, single-seat, midwing, all-metal monoplane with retractable landing gear, designed to operate from carriers or land bases. Its wing span is 38 feet; over-all length, 28 feet, 11 inches; height on the ground, nine feet, two inches.

Wildcats flown from carriers or from

Henderson Field on Guadalcanal by either Navy or Marine pilots helped bring victory at the Solomons, at Midway, and in other Pacific battles. Fighting Squadron Five of the Navy, which carried the "striking eagle" as an emblem, was typical of the men who used it.

There were 36 original members of this squadron, and 14 more flying officers were assigned to it during fighting in the Solomons. These flyers averaged 24 years old. They came from 26 states. Nine are now listed as missing in action; three are known to have been killed. Seven were wounded.

The squadron, which first went into action August 7, had an average training of 12 months per man. Many of the fighters had more training. Four were Annapolis graduates, and the rest were brought into the squadron from the reserve as the Navy expanded. The squadron was decommissioned in December, 1942, and its members are now scattered in other duties. Commander Simpler is in Washington, D. C., attached to the Navy Department.

"We first got these Wildcats in Bermuda, in June, 1941," Commander Simpler says. "They created quite a stir among the personnel. Naturally, the squadron commander insisted on being the first to fly one. It gave us 50 percent better performance in practically everything than the planes we'd flown before. It took a little time to get used to them, because there is a lot of difference between making a run on a target at around 200 miles an hour and at around 120. It took time to adjust ourselves to formation flying, carrier landings, and everything else.

"But we were trained all right by the time we reached the Solomons. Trained in teamwork. Teamwork is everything.

"Because of this training, there wasn't half the excitement the first morning we

JAPS GIVE AND TAKE IN SOUTHWEST PACIFIC

This was a hangar for U. S. Navy planes on Guadalcanal, until a Jap bomber scored a direct hit on it. For weeks, Wildcats fought against heavy odds to guard ground forces on the island from aerial attack

Navy planes proved that they could dish it out, too. Below, a pillar of black smoke rises from a burning Japanese gasoline dump on Tanambogo Island in the Solomons. Air and surface craft of the Pacific Fleet pounded this enemy base as a prelude to Guadalcanal landings

Official U. S. Navy Photos

FIGHTING SQUADRON FIVE on Guadalcanal. After fighting from its carrier through the first month of the Solomons campaign, the squadron moved into battle-scarred Henderson Field on September 11, 1942, and stayed there under continual attack until October 15. The Jap flags stand for enemy planes. Right, Commander Simpler

went into action that there was when we boarded the carrier to go out on the Pacific, knowing we were going to get into action. We were absolutely confident. We had our instructions. We knew our planes. We knew what we were going to do, and we did it.

"Our first mission was to protect Marine landings on Guadalcanal, and our take-off from the carrier was before dawn. The take-off was pretty. The air was perfectly smooth. The moon was still a few degrees before setting. The ceiling was fairly high and broken. Ours was an attack group composed of 12 fighters. Its main mission was to strafe Henderson Field, destroy any aircraft found there, and sweep the adjacent area for any other fields that might possibly be there.

"As we came up in the early dawn, we could see our own transports with their escorting cruisers and destroyers far beneath us, and they were a beautiful sight. We were just approaching our attack point when the first U. S. warship opened up with its guns. Our own attack was just like any other strafing drill. We saw hangars below us and we went down and let them have it. There was a truck running across the field and we destroyed it absolutely. Then we roved around, strafing the buildings under the trees that we supposed must contain the Japs. Then we went back to the carrier."

A second patrol went out, Commander Simpler says, which ran into an overwhelming force of Japs coming "down the highway" from Rabaul. They attacked, and lost four out of eight, but a third patrol went up and brought down 13 Japanese planes definitely, four probably, with two "assists," without the loss of a single American plane.

"What is the margin of superiority of the

Americans over the enemy?" Commander Simpler was asked.

"It's the combination of man and plane," he answered. "Naturally, it's both, for the best plane won't win if it isn't operated to maximum efficiency. Up against the Jap Zero we had the disadvantage of going against a plane with greater maneuverability and greater climb. Our speeds were about equal. But the Jap was in a tinderbox. You hit him and he burns. The Wildcat is tough. It's got the armor and it's got the fire power. You win by taking advantage of what you've got.

"The Jap pilot is brave, all right. But he doesn't seem to be as alert as our pilots. Many times he either doesn't see you, or doesn't care to press an engagement. Maybe if you were riding around in a tinderbox, you'd develop a little disinclination to get hit. Their bombers burn just as quickly as their fighters, and we've certainly brought back our Wildcats full of holes.

"One man in our squadron, 'Smoky' Stover, even brought back his plane after a head-on collision with a Jap float biplane. He was so interested in shooting this Jap that he didn't dodge him, and collided head-on. The Jap plane went down into the sea, but 'Smoky' brought his own plane home with one wing bashed in."

The second major action for Fighter Squadron Five occurred on August 24, when a big Jap task force of transports, carriers, cruisers, and battleships came south from Rabaul in a vain attempt to reinforce the enemy forces on Guadalcanal. As against 19 Japs brought down, Fighter Squadron Five lost only three.

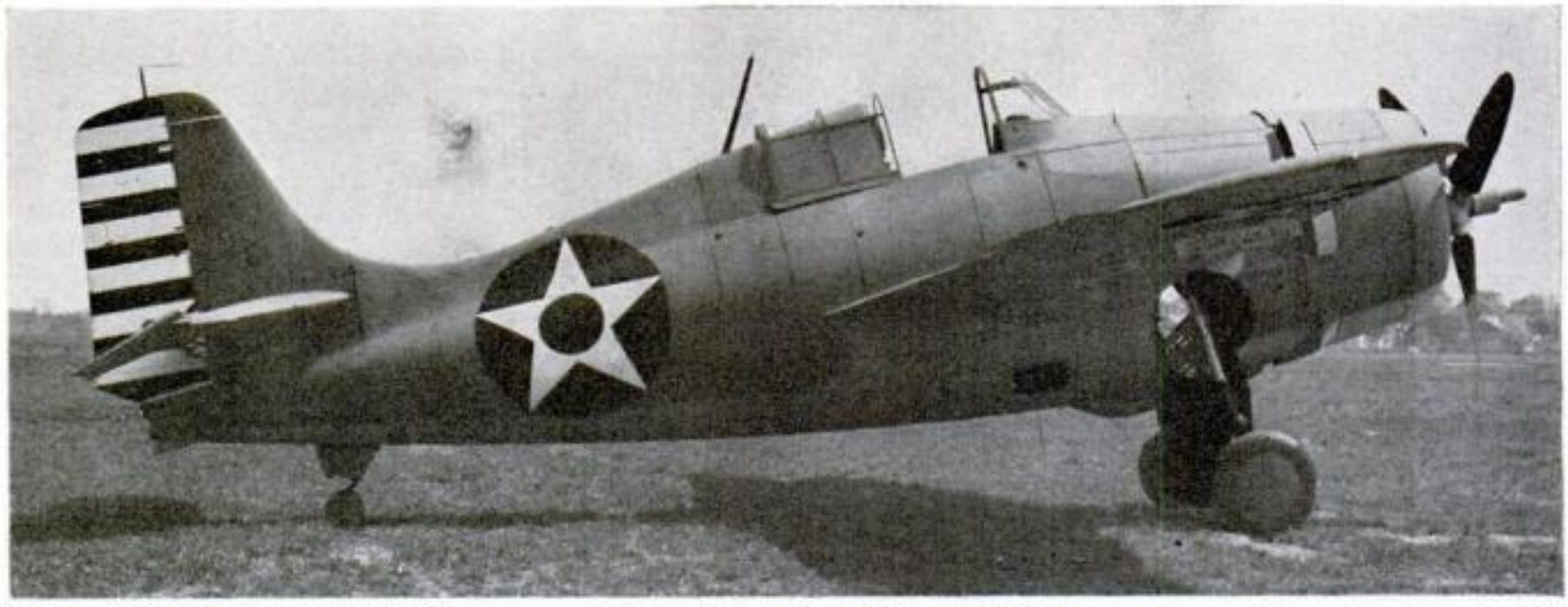
"Shortly after lunch aboard our carrier," Commander Simpler remembers, "enemy patrol planes appeared near us and were destroyed. Then our scouts picked up an enemy carrier task force about 250 miles away, and an attack group was launched which destroyed an enemy carrier. We didn't escort these planes because the action was too far away. We had our own troubles protecting our own carriers.

"Japanese dive bombers came in from about 22,000 feet about 5:30 in the afternoon. They were diving through a terrific hail of antiaircraft fire, and right on their tails our fighters followed. The first Jap to drop a bomb was brought down immediately by the fighter on his tail. About three quarters of the Jap bombers were destroyed either by our ships' gunfire, by our fighters, or by our bombers returning home. During the fight the enemy apparently put the flight deck of one of our carriers out of commission. There was a lot of hubbub and confusion. We had two carriers in this engagement, and when one was temporarily out of commission we made landings on the other. Teamwork extended throughout the entire task force.

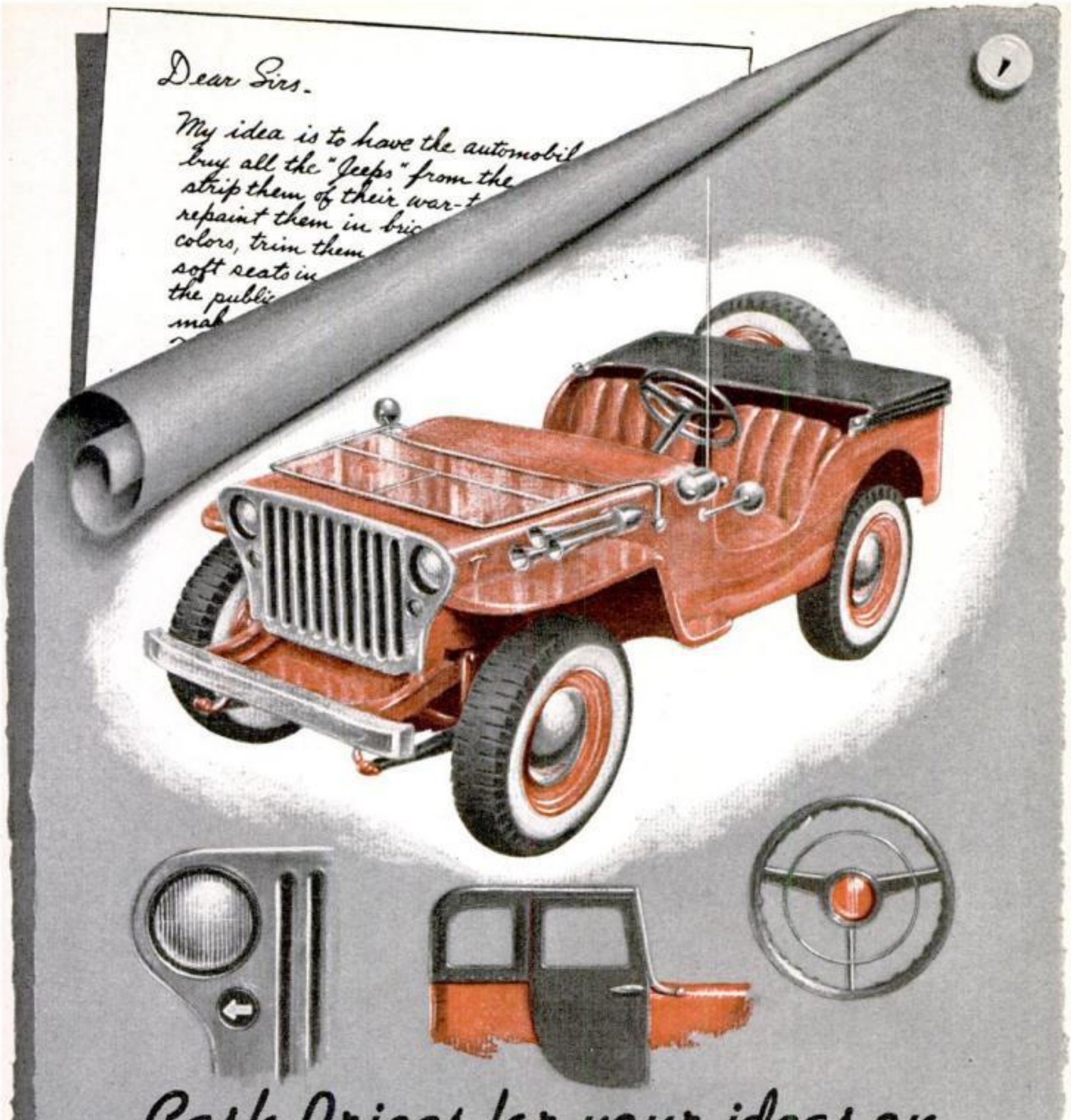
"Soon after that fight, we flew our planes to an island base near Guadalcanal and on September 11 flew in to Henderson Field. We certainly got a great reception. There were only eight planes remaining on the island at that time, and all the ground forces were glad to see us. The Japs were fighting then at the very edge of the field.

"On the first morning's patrol we started to find our planes while it was still dark and rifle fire was crackling near by. I remember I stumbled into a machine-gun pit. A low, tense voice said, 'What's the password, buddy?' Nobody had given me any password, and I knew I was pretty well covered. I said I was an American flyer looking for his plane, and the Marine in the hole said, 'Okay, buddy.' I was pretty relieved.

"In continuous fighting against Japanese air attack from *(Continued on page 204)*



THE GRUMMAN WILDCAT is powered by a Pratt & Whitney 1,200-hp. engine with a Curtiss electric three-bladed propeller. Its speed is officially set down as "over 300 m.p.h.," its range as "over 1,000 miles." Heavy armor protects pilot and vital parts. Jap Zero pilots think twice before they tackle it



Cash Prizes for your ideas on Peacetime Jobs for Jeeps

WHEN the war ends, what will be done with all the jeeps? Neil F. Smith, of Cleveland Heights, Ohio, suggests that automobile manufacturers buy them up, paint them in bright colors, and add peacetime accessories like those shown above. Distributed to civilians, they would fill the gap while the car makers convert from war production.

POPULAR SCIENCE MONTHLY offers $200 in cash prizes for the best ideas submitted on peacetime jobs for the jeep: First prize, $100; second, $50; third, $25; and five prizes of $5 each. Put your ideas in a letter of 250 words or less and mail to Contest Editor, Popular Science Monthly, 353 Fourth Avenue, New York, to arrive on or before September 1, 1943. The editors of this magazine will be the judges, and their decision will be final. In case of ties, each tying contestant will be awarded the prize tied for.

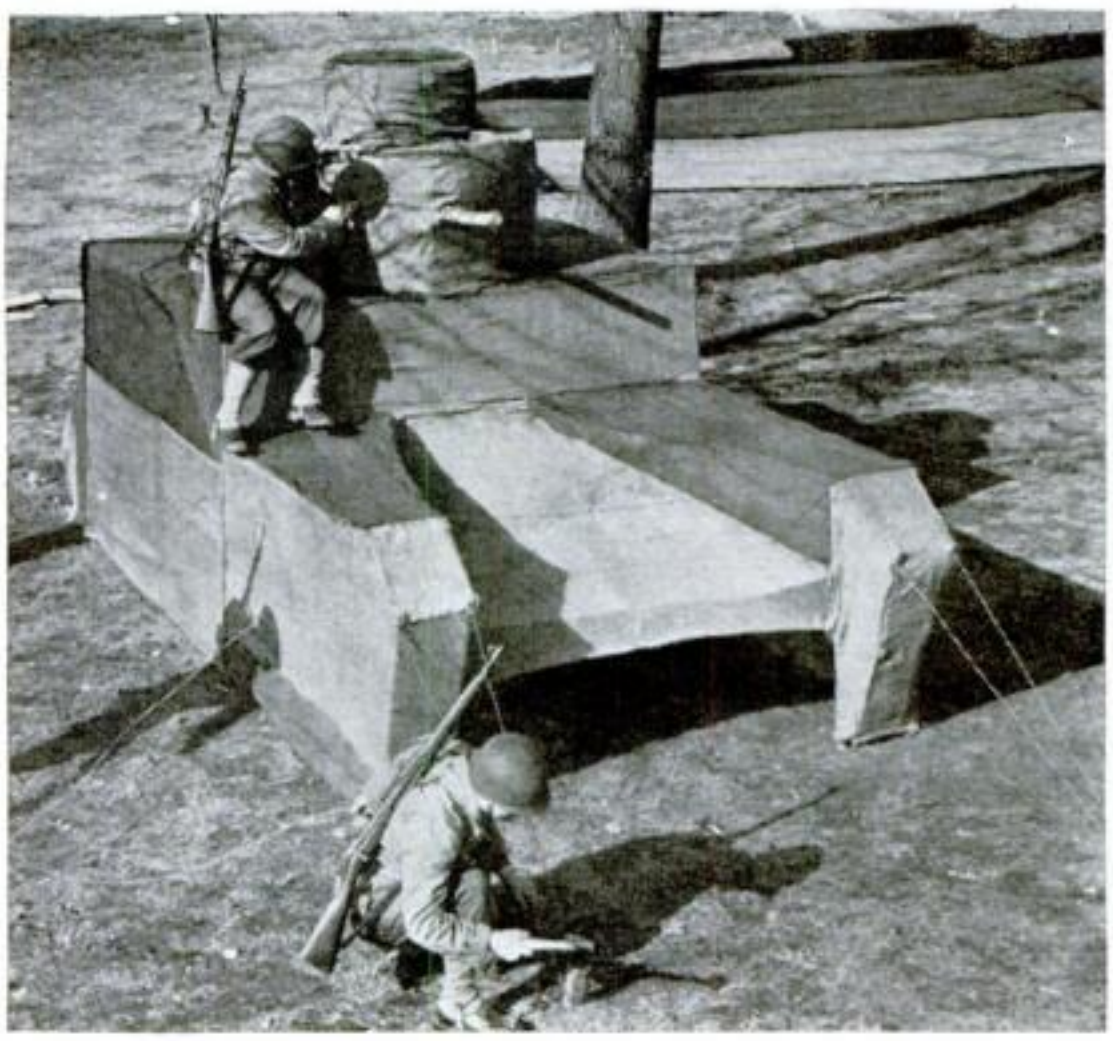
Decoys Trick

THESE jerry-built replicas of American war machines, made of wood and burlap and poorly camouflaged, attract the fire of enemy batteries and dive bombers, while the real and adroitly concealed wallopers do their work. Faked antiaircraft guns, mean-looking antitank guns, and 155-mm. rifles like the one shown here are factory-made at the Engineer School, Fort Belvoir, Va. But Army camouflage experts, on short notice, can throw together decoy tanks and planes made of burlap, or field guns hewn from tree trunks, that fool air observers from as close as 500 feet. Such tactics are probably as old as war itself—but they still work. One of China's most successful ruses is a fake landing field on which a dozen or so planes appear ready to take off. Actually the planes are nothing but silhouettes, cleverly painted on the ground with tar. Yet Jap raiders have been known to make repeated bombings on such a field, which, in between raids, is daubed with fresh tar by the chuckling Chinese. American engineers have adopted the trick, but have improved the "bait" by making the planes out of burlap, which is stretched on wood and wire frames as shown in the photograph.

Rolling on wooden wheels painted so that they will look like rubber tires, this simulated 155-mm. rifle can't fire even wooden shells—but it can make the enemy waste steel ones, as well as bombs, trying to hit it

The "plane" these men are building may not look to you like a convincing replica of the Airacobra at lower left, but to an enemy pilot at 500 feet it's the real thing

Enemy Into Wasting Fire

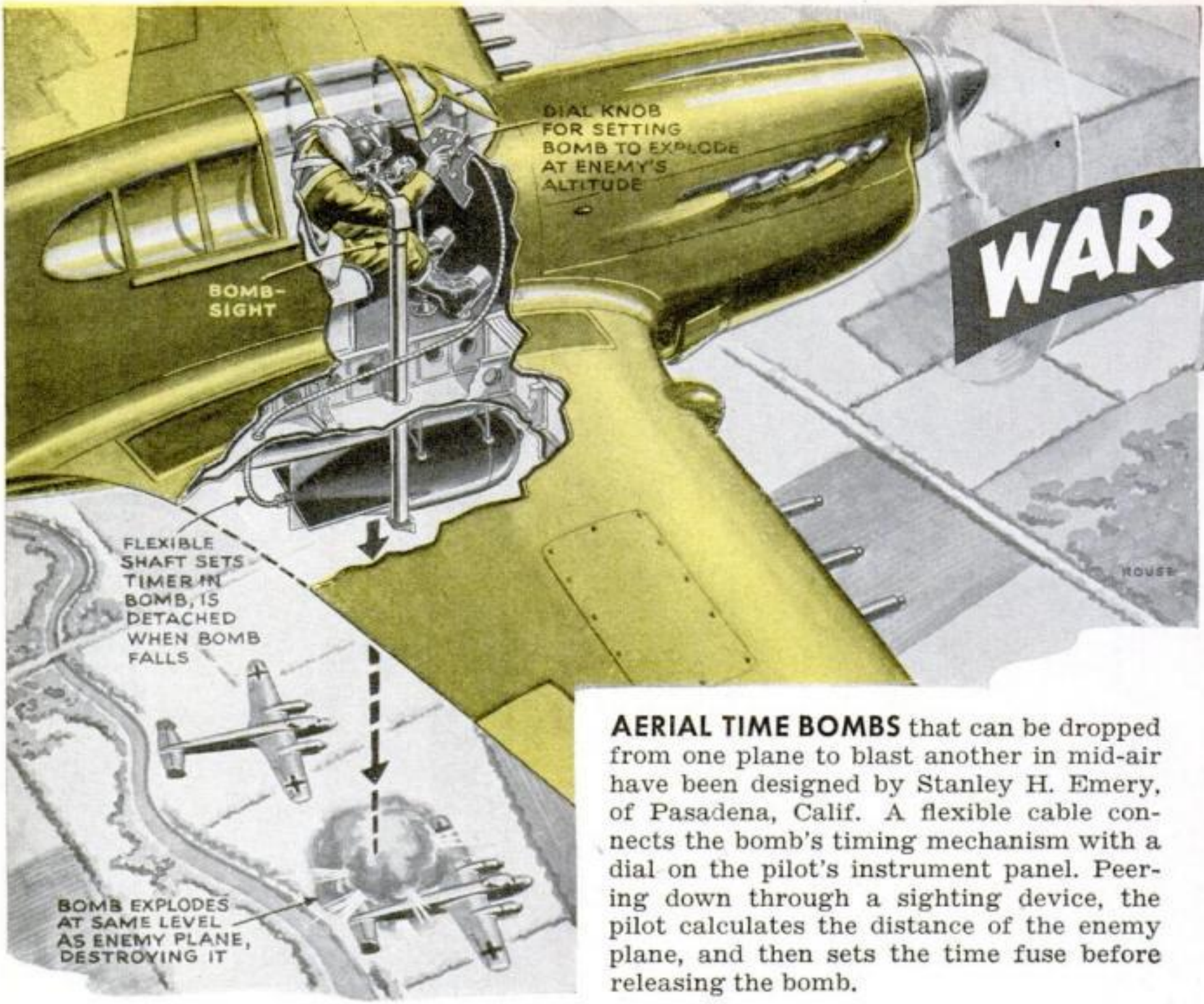


Looking like a fourth-rate float at a second-rate Mardi Gras, the decoy light tank at left, parked under a tree, brings a shower of bombs from enemy flyers who think they have surprised one of our M-3's. The actual tank is shown directly above (P.S.M., Mar. '43, p. 123)

Photographs of decoys by William W. Morris

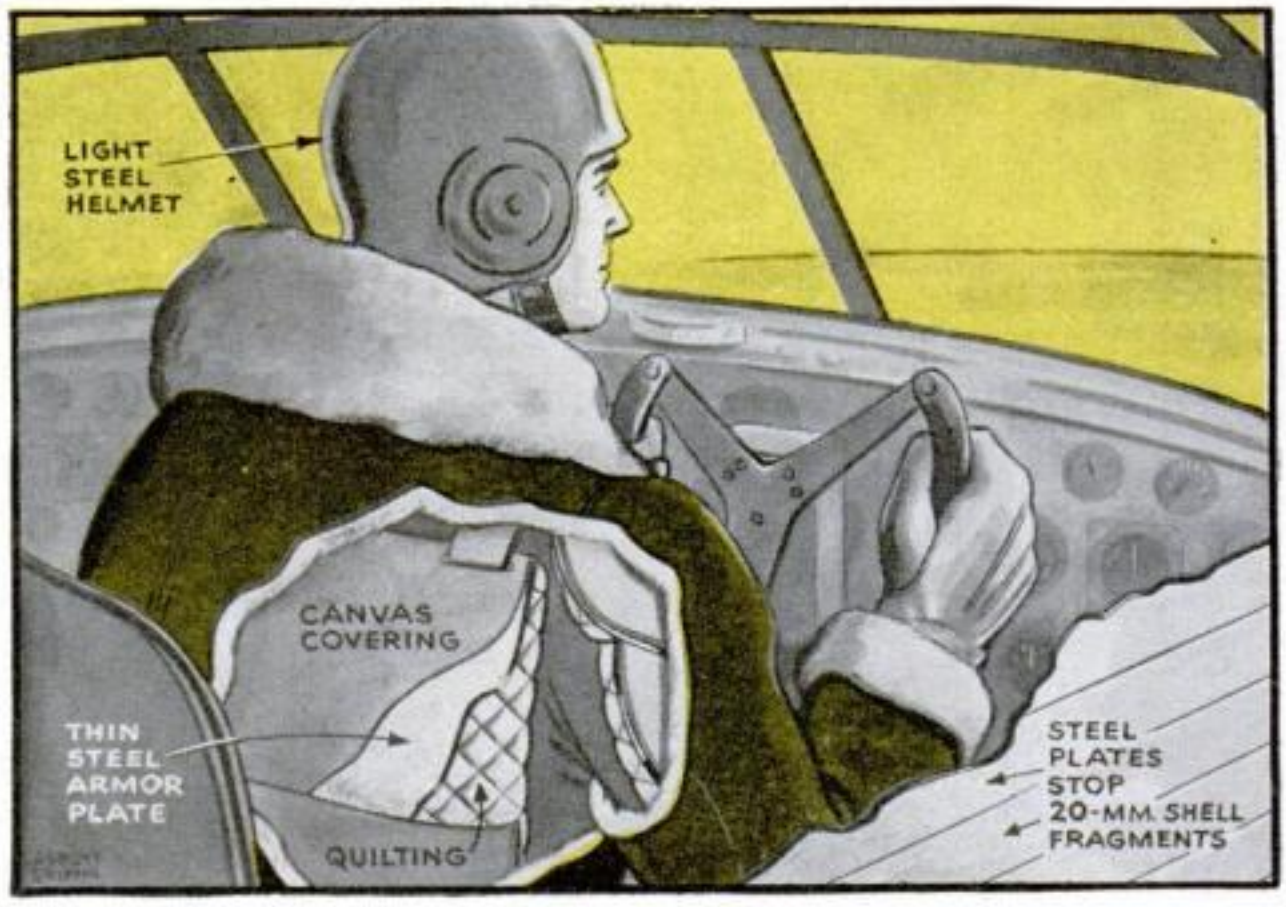
At right is a wooden counterpart of our 37-mm. antiaircraft gun, shown below. An important part of the ruse is to pose the weapon realistically, and not to "conceal" it either too well or too poorly

This wooden 37-mm antitank gun is a good example of how authentic a decoy can be made to look. It cost only a few dollars to make, but it should cost the Axis thousands in the ammunition that will be expended in the effort to smash it

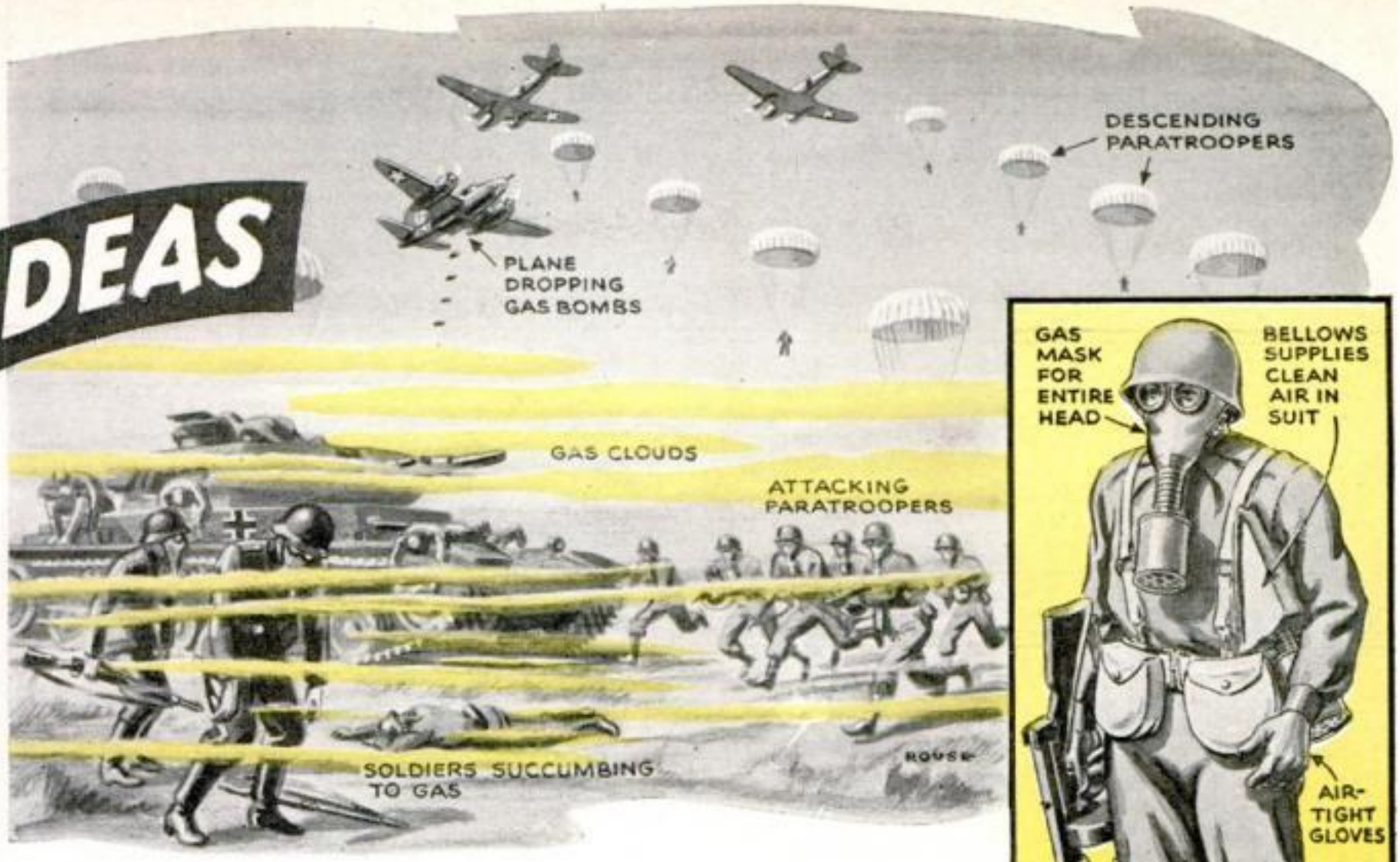


AERIAL TIME BOMBS that can be dropped from one plane to blast another in mid-air have been designed by Stanley H. Emery, of Pasadena, Calif. A flexible cable connects the bomb's timing mechanism with a dial on the pilot's instrument panel. Peering down through a sighting device, the pilot calculates the distance of the enemy plane, and then sets the time fuse before releasing the bomb.

BOMBER-CREW ARMOR made of steel and somewhat similar in design to the guards worn by football players, is proposed for use among Allied flyers operating over Germany. Weighing 15 pounds, the armor, still in an experimental stage, covers almost the entire body, and is held on with adjustable straps. A light steel helmet completes the outfit, which has proved particularly effective against flak fragments. It is limited to bomber use, as it does not permit enough freedom of movement for fighter pilots.



IDEAS



GAS-RESISTANT SUITS that would enable our troops to attack the enemy in areas on which a surprise barrage of vesicant gas had been laid down by plane, have been suggested by Cpl. Harry Giffords, of Congaree Army Air Field. Made of an airtight material, the suit fastens at the base of the wearer's mask, and covers the entire body except for the hands and feet, on which special airtight gloves and boots are worn. A bellows attached to a decontaminating chemical canister could be operated periodically to draw air into the suit.

"IRIS SHUTTER" SIGHTS, similar to the diaphragms on cameras, have been devised for the rifles of snipers and other special marksmen. The shutter is first opened wide to enable the rifleman to "frame" his target; then gradually closed until it encircles only the target itself. The new shutter sight was designed by John Beresky, of Brooklyn, N. Y.

BOOBY-TRAP WHISTLES have joined fountain pens, watches, and fat wallets as Axis "come-ons" for blasting unsuspecting Allied soldiers. A charge in the body of the whistle is fitted with a striker and cap. When the whistle is blown, the vibrating pea hits the striker, which in turn sets off the charge.

Stephen M. Dessau examining stones to be set on disk rims 10 inches in diameter. These will be used as circular saws for cutting the toughest alloys that only diamond teeth can cut

Diamonds by the Ton

MAKE TOOLS TO GRIND THE AXIS

Three fourths of all the diamonds mined go to work for industry. Last year alone, the number of "precious stones" used for the building of war materials cost more than several battleships.

Photographs by ROBERT F. SMITH

THROUGH a peekaboo window at the entrance of a New York office suite, a reception girl looks you over. She opens a shutter and asks your business. A satisfactory answer, and you are admitted to a treasure house of jewels.

Industrial diamonds are what you have come to see. Your experience at the doorway has already fostered your respect for them. True, they will never grace a pretty finger or wrist. Destined for tools rather than ornaments, they will be handled by workers in overalls. But if you have imagined that the diamonds of industry are cheap, imperfect stones, you will soon be enlightened.

From one of many paper packets in his office, Maurice S. Dessau, head of the Dessau Diamond Tool Company, spills white, sparkling five-carat stones that an untrained eye cannot distinguish from gem diamonds. He points out one of perfect quality, save for a tiny black speck of carbon, so deeply embedded that no amount of polishing would remove it. Another stone has a knotty, cross-grained structure that would make its polishing difficult. For industrial purposes, however, they are ideal. Diamonds vary slightly among themselves in hardness; and those selected for commercial use actually serve better than gem diamonds, which are softer.

Diamonds for industrial tools, therefore, command a price of $30 to $50 a carat—a long way from being ugly ducklings. Their cost would soar far higher if they were not by-products of the mining of gem stones. Three fourths of all diamonds go to work. Last year's output of diamond tools required more than a ton of industrial diamonds, equal in cost to several battleships.

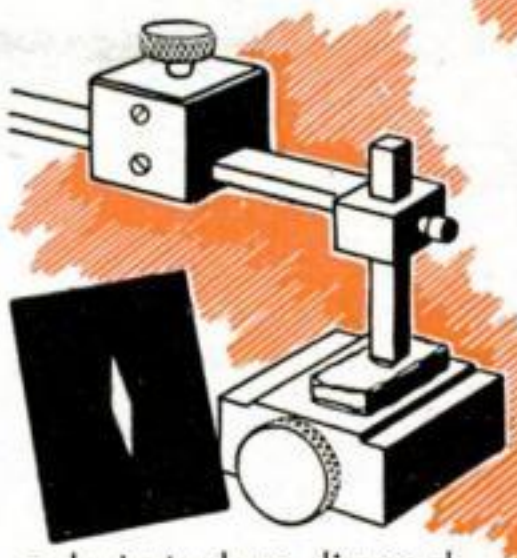
Typical shipments imported from Africa and South America include stones of many tints besides white—"African grays," brown "bortz" and "ballas," and the black diamonds known as "carbons," or "carbonadoes." The last are found only in Brazil. Diamonds even from neighboring localities may differ markedly in characteristics and are known to the trade by the name of the mine from which they come—

Premiers, Bultfonteins, and Jagers, for example. In all, about 35 different kinds of industrial diamonds are marketed.

Advising users as to the correct type of diamonds and diamond tools for their particular needs is the specialty of Stephen M. Dessau, son of Maurice and fourth-generation member of the firm. One kind of diamond, he explains, may be specifically suited for a certain task—for example, "carbon" for rock drills. In cases that allow a choice, the skill of the tool operator may decide it. A veteran worker obtains maximum production with an extra-hard but brittle diamond; a novice is better entrusted with a diamond slightly less hard, but also less easily damaged.

Most industrial diamonds, it has been estimated, serve for truing the cutting faces of the grinding wheels used throughout industry for shaping metal and other

1 A simple manual test shows that a diamond can scratch any mineral, but cannot be scratched except by another diamond

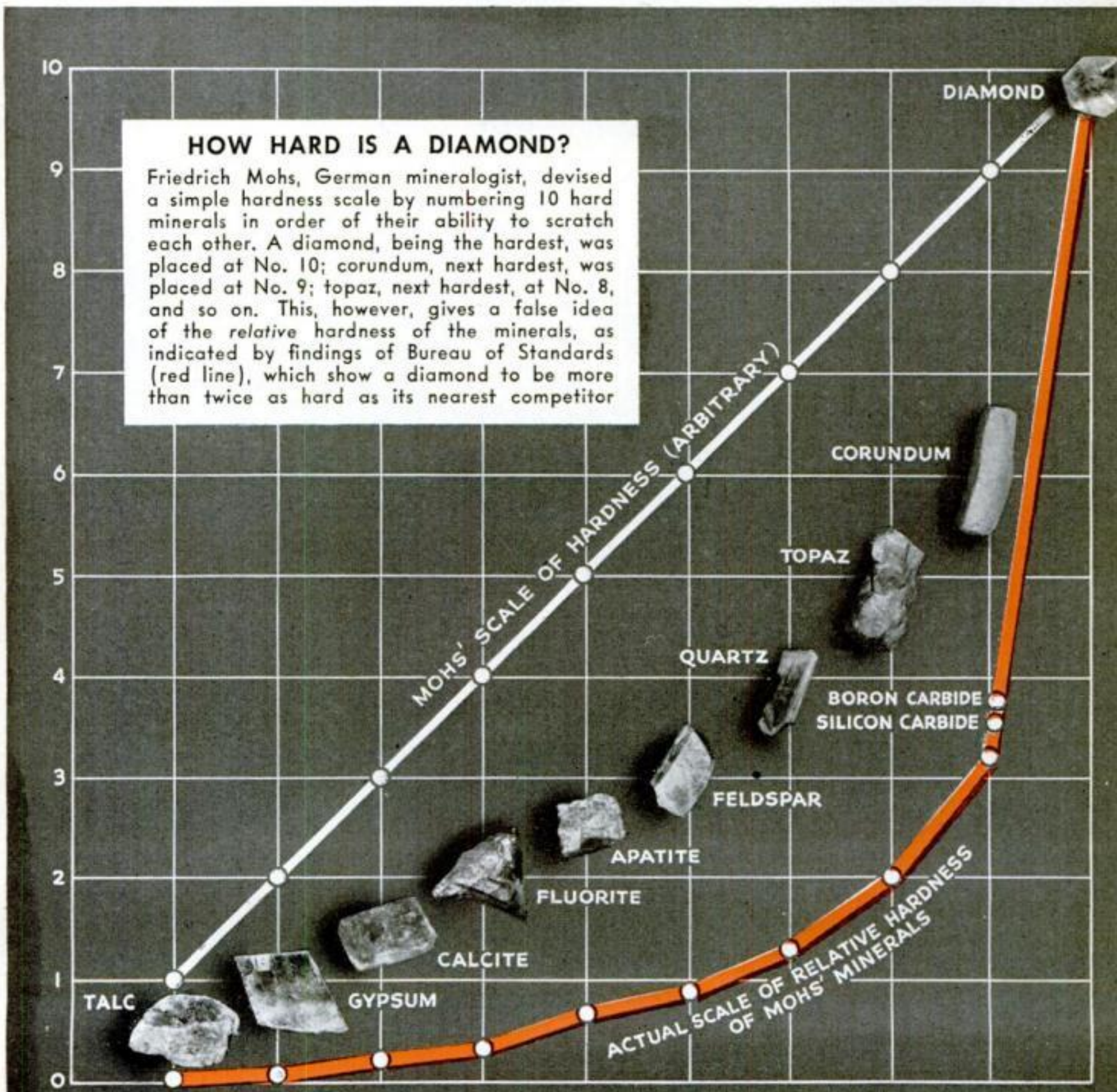


2 A tiny dent, made by a diamond-pointed, weighted metal bar on surface of a mineral, is measured to show the mineral's hardness

3 In test where diamond and five other "tough" minerals, sealed in a resin disk, are exposed to long wear, diamond wins

HOW HARD IS A DIAMOND?

Friedrich Mohs, German mineralogist, devised a simple hardness scale by numbering 10 hard minerals in order of their ability to scratch each other. A diamond, being the hardest, was placed at No. 10; corundum, next hardest, was placed at No. 9; topaz, next hardest, at No. 8, and so on. This, however, gives a false idea of the *relative* hardness of the minerals, as indicated by findings of Bureau of Standards (red line), which show a diamond to be more than twice as hard as its nearest competitor



materials. When the worn-down surface becomes too uneven for precision, a diamond tool is drawn across the revolving wheel, restoring its regularity by cutting away microscopic ridges of the abrasive. Then the wheel goes back to its work of producing parts for airplanes and myriads of other products.

In boring and turning operations, industrial diamonds impart a mirrorlike finish to metals. Spectacle lenses are cut with a diamond, shaped with a diamond-impregnated wheel, and drilled with a diamond-pointed drill. The whole electrical and wiring industry depends upon diamond dies to draw wire to uniform size, through holes in the wear-resisting jewels. Diamond wheels cut pieces of quartz for war-important radio use. Powder made by crushing diamonds serves for lapping metals as hard as tungsten. During wartime, industrial diamonds play an all-important part on the home production front.

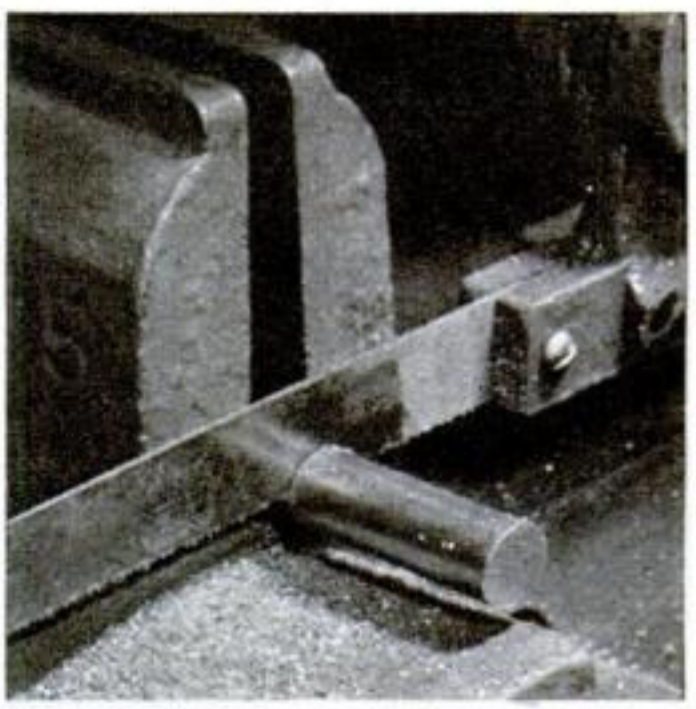
Since users of diamond tools care nothing about the fiery reflections a skilled gem cutter can give a stone, most industrial diamonds are uncut stones. Natural points of the stone, just as it is found at the mine, do the cutting. Turning a diamond tool frequently in its holder assures even wear and keeps the exposed point sharp. When long use has worn it away, the diamond tool is returned to its manufacturer for "servicing." This means simply removing the diamond from its "setting," turning it around to expose a new point, and remounting it in the tool. Of the several shapes in which diamonds naturally crystallize, the eight-sided kind called an octahedron, resembling a pair of square pyramids joined at their bases, is preferred; it may be reset five or six times before its natural points are consumed.

Oversized industrial diamonds, like gem stones, are usually split into smaller ones. Sometimes, however, extraordinary specimens turn up. This writer had the thrill of holding in the palm of his hand four giant

HOW DIAMOND TOOLS ARE MADE AND USED TO TRUE UP

1 Oversized stone to be cleaved in tool. Cutting plane is first marked with another diamond

2 Cleaving knife, fitted in notch, is tapped lightly by hand to cut diamond at the exact place desired



3 Sawing cold-rolled steel to be used in making a holder for a diamond-point wheel-dressing tool

7 Beveling away the steel around the diamond tip gives the tool a conical end. It is ready for use

8 The approximate value of this group of finished diamond tools is set at $3,600. The oversized heads are specially designed to prevent overheating. These tools will play an important part in building war materials

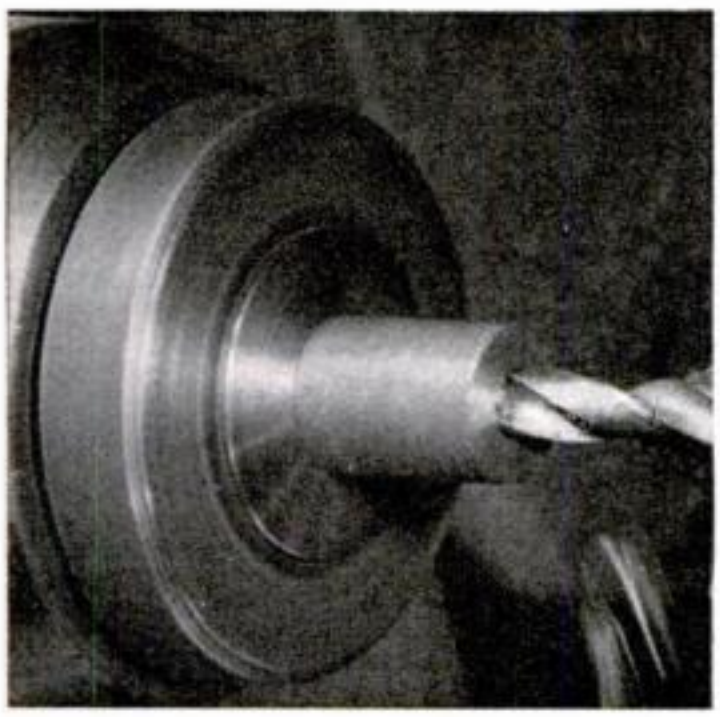
brown "pebbles" from Africa, almost beyond valuation because of their rarity. The largest of these solid diamonds, which tips the scale at 150 carats, rivals the famed Koh-i-noor in bulk, and the rest compare with other historic gem diamonds. For industrial use, the biggest stone would be reduced to about 25 smaller ones. But the demand of natural-history museums for such remarkable show pieces will probably spare it from the cleaver's blade.

The same quality that protects gem diamonds from scratching and wear accounts for the use of diamonds in industry. They are by far the hardest substance, natural or artificial, known to man. Hence they can cut, shape, and polish pieces of any other material.

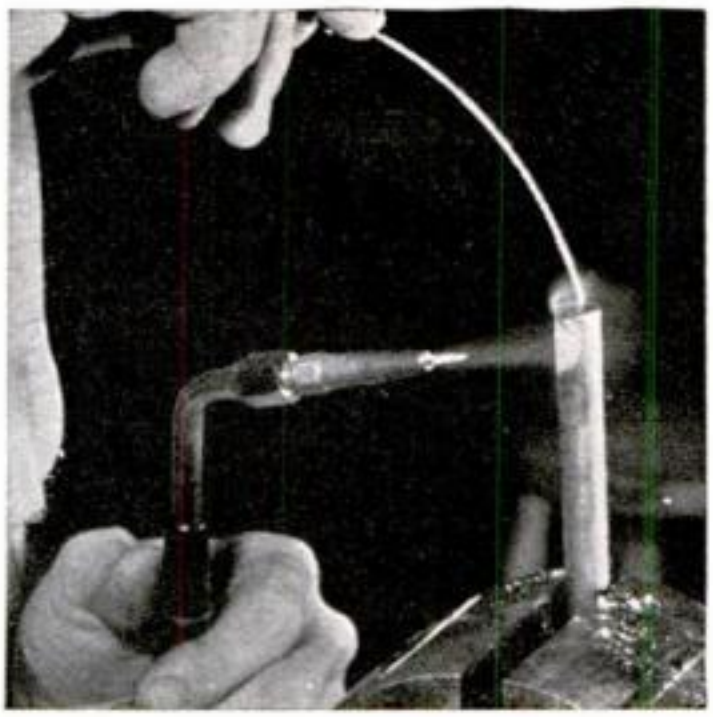
How can a diamond's hardness be compared with that of other abrasives—and of gems? Away back in 1820, a German mineralogist named Friedrich Mohs devised a crude but simple scale. Choosing 10 familiar minerals, he gave them ascending numbers in the order of their ability to scratch one another. Talc, softest and most easily scratched of all, became No. 1. Diamond, the hardest, received top place as No. 10. Others in the high bracket are topaz, No. 8; and corundum, of which both emery and rubies are varieties, No. 9. When synthetic abrasives harder than corundum came on the scene, they fitted into Mohs' scale at in-between places like 9.1 for silicon carbide and 9.3 for boron carbide.

Right there, where comparative hardness matters the most, the misleading nature of Mohs' scale of hardness becomes especially striking. These artificial abrasives appear, from their numbers, to approach the hardness of a diamond—but they don't. Actually the intervals between the German professor's minerals are grossly unequal, and the gap between corundum and the diamond exceeds all the others combined! Beware, therefore, of wrongly interpreting "hardness numbers," based on this scale, which still appear in standard works. *(Continued on page 210)*

GRINDING WHEELS THAT SHAPE THE MATERIALS OF WAR

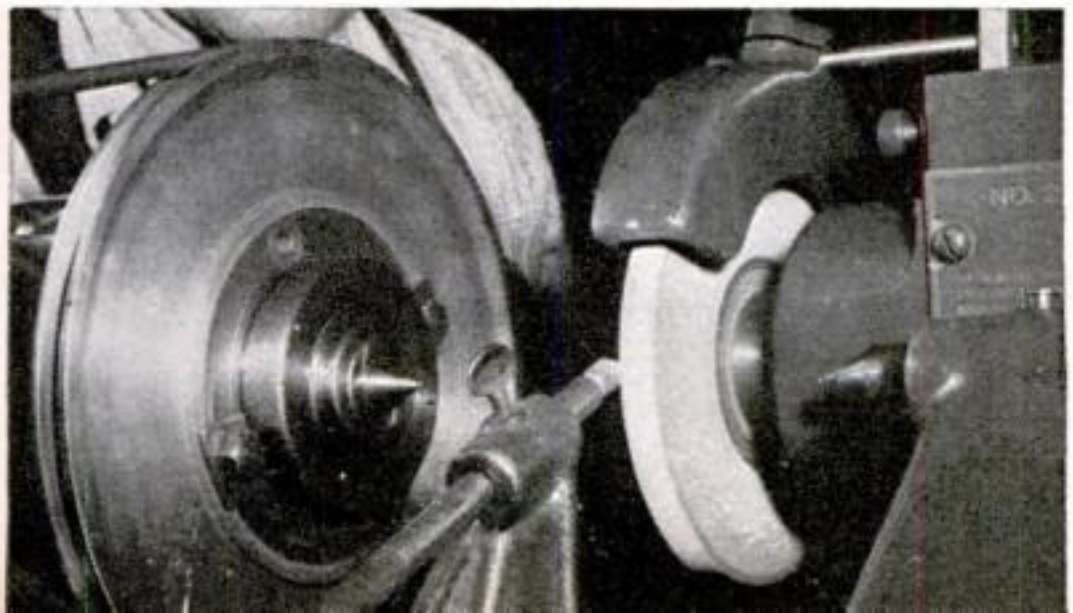


4 A hole for inserting the stone is drilled into the end of the holder to receive the diamond tip

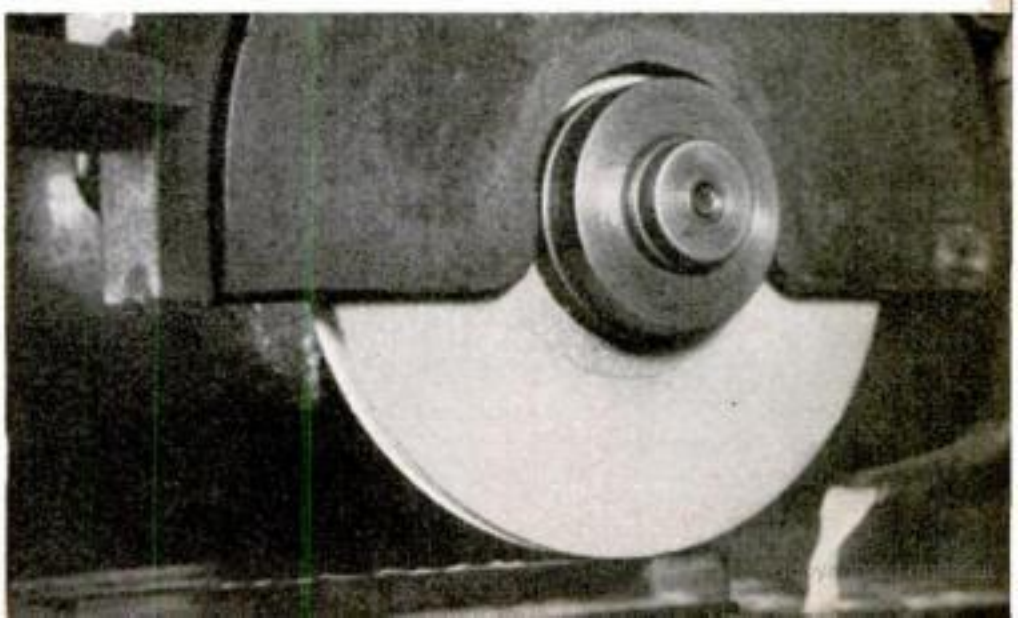


5 Solder of special composition is melted into the hole with the heat from a small blowtorch

6 With forceps a deft worker inserts a diamond tip into the hole while solder is warm



9 This photo and No. 10, taken at Brewster Aeronautical Corp., show use of industrial diamonds in making airplane parts. A diamond tool trues a grinding wheel



10 Ridges in abrasive on worn grinding wheel have been removed by diamond tool. Production goes on. With diamond's help, America grinds the Axis

The Flat-Top

Test of Battle Shows Its Place

A fighter plane taxies up to the take-off line on the flight deck of one of our carriers, as the director waves him on

Carries On in Naval Warfare

Aircraft carriers got their baptism of fire in the present war. How have they stood up? How have the lessons of battle affected their construction and use? This article gives the answers.

By ALDEN P. ARMAGNAC

SHORTLY before her gallant end in the Far East, the U. S. aircraft carrier *Lexington* experienced one of the strangest of wartime adventures. Nine bombers, appearing out of thickening dusk, maneuvered as for a normal landing. But all of the *Lexington's* bombers were aboard and accounted for. Suspicion turned to certainty when an American scout plane in the air opened fire on the strangers. They were Japs, who had mistaken our carrier for one of their own. Discovering their error, they hastily turned tail. Some of the *Lexington's* crew still think it would have been fun to let them land.

Perhaps such a fantastic incident could happen only aboard a carrier—a kind of ship that is rewriting the rules of naval strategy. Lightly armed and armored, its real "artillery" consists of dive bombers, torpedo bombers, and fighter escorts, which give it about 20 times the striking range of the most powerful naval guns. For "armor" it depends mainly upon its own fighting aircraft. Tested for the first time in this war, it has proved capable of missions that its designers never dreamed of.

Originally, carriers were intended to supplement surface forces in major fleet actions. A concession to the growing importance of air power, they would remain safely guarded in the rear while their planes neutralized enemy air forces and left the decision, as always, to the mighty battle wagons of the sea.

It took Pearl Harbor to show us what else our carriers could do. All our naval tradition called for attack—but with what? Every surviving battleship of our Pacific Fleet lay temporarily disabled at Hawaii. So we flung against Japan our ace in the hole, our fleet of seven aircraft carriers.

Task forces of cruiser-escorted carriers raided Jap-occupied Marshall and Gilbert Islands, Wake Island, and the Marcus Islands. Perhaps the actual damage done had little more than nuisance value. Far more important, we were testing a bold new technique in naval warfare. We found that our carrier forces could pinch-hit for capital ships. Moving swiftly under cover of airplane reconnaissance, and of rain squalls and overcasts, they could be projected anywhere upon the high seas—even deep into regions supposedly controlled by the Japanese.

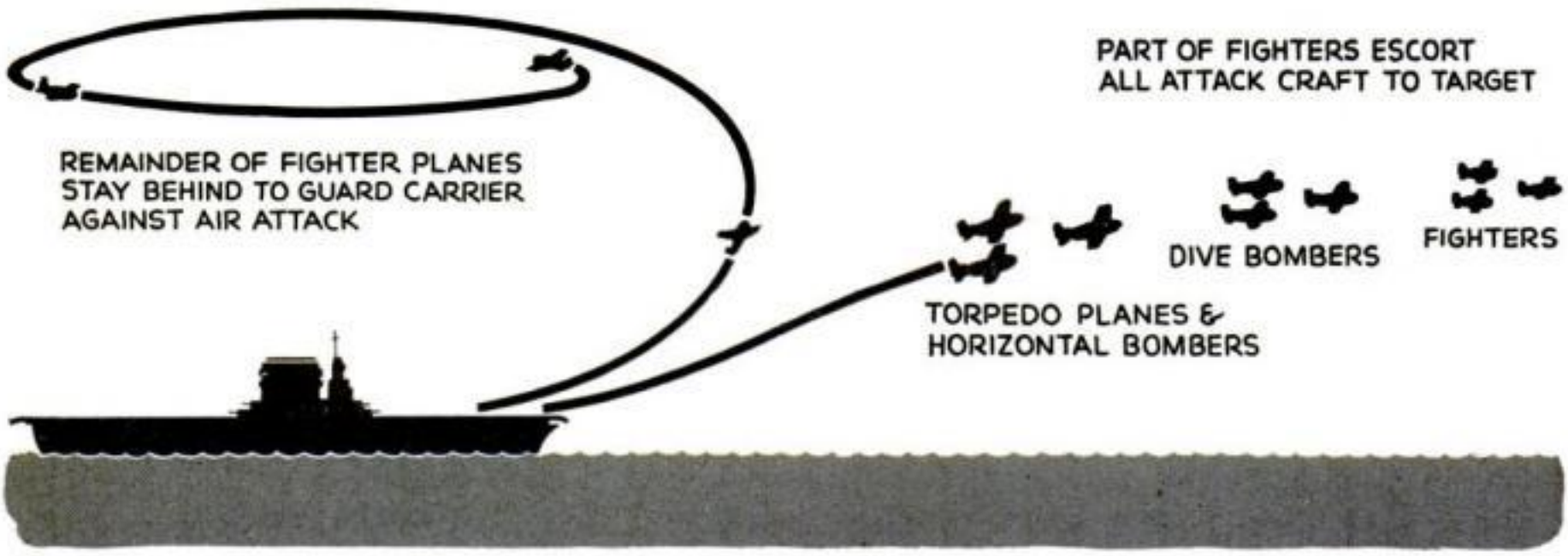
Then came blows that really hurt. American carrier raids on the Jap bases of Salamaua and Lae, in New Guinea, sank 20 ships and delayed Nipponese plans to advance southward for two months. At Tulagi Harbor in the Solomon Islands, our carrier planes surprised another invasion fleet and practically annihilated it.

In the Battle of the Coral Sea, the memorable radio flash "Scratch one flattop" announced the sinking of Japan's big new carrier *Ryukaku*—demolished in a few minutes by 25 bomb and torpedo hits from U. S. carrier aircraft.

The Battle of Midway shattered a Japanese armada bent on seizing that strategic island—"unquestionably in preparation for an attack on Hawaii, and, perhaps, even an assault on continental United States," declares Secretary of the Navy Knox. Working in close co-operation, the Navy's carrier planes and the Army's Flying Fortresses sent four Jap carriers to the bottom of the sea.

By the time that U. S. battleships reappeared in the news, during the series of naval engagements off Guadalcanal Island, our carriers already had definitely stemmed the tide of Japanese conquest. Naturally our losses had been heavy—but so were the enemy's. *(Continued)*

THE CARRIER HURLS HER "ARTILLERY" AGAINST THE ENEMY



When scout craft report the presence and location of the enemy, the carrier's planes take off. The fighters guard their own vessel and tackle enemy fighters; dive and torpedo bombers strike the foe

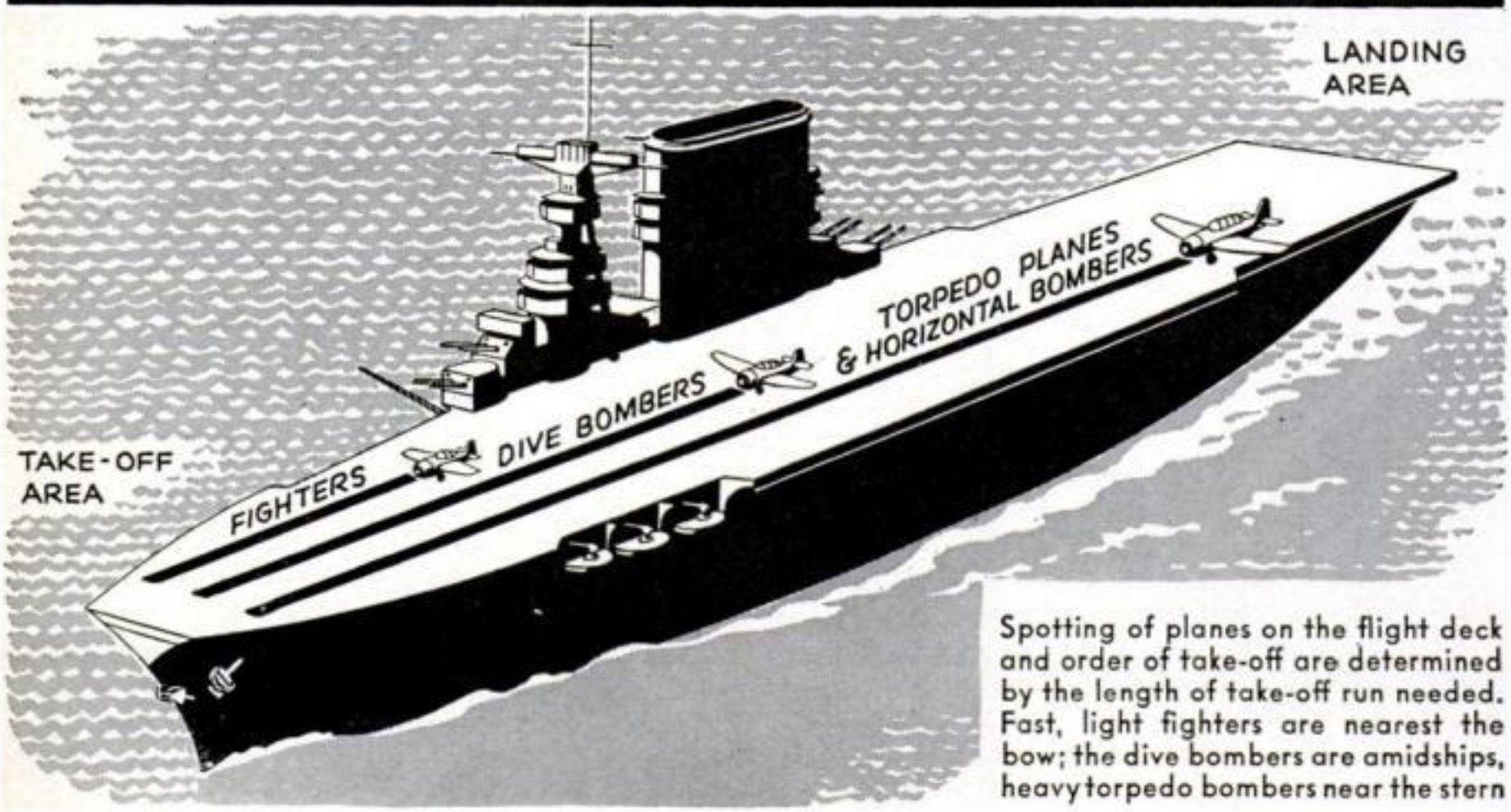
Of the 14 carriers, many built secretly, that Japan now is believed to have possessed, the U. S. Navy currently reports the following disposition: six sunk, one probably sunk, and seven damaged. Taking into account the Navy's reputation for ultra-conservative claims, the actual score may be considerably higher. Perhaps this accounts for the disastrous absence of Japanese carriers in the major battle of Guadalcanal last mid-November—a smashing American naval victory—and in the battle of the Bismarck Sea, last March, when an entire Jap convoy of ten warships and twelve transports was destroyed from the air.

As to our own carriers, we retain three of our original seven, at this writing—the 33,000-ton *Saratoga,* sister ship of the lost *Lexington;* the 20,000-ton *Enterprise,* sister ship of the lost *Yorktown* and *Hornet;* and the 14,500-ton *Ranger,* comparable in size to the lost 14,700-ton *Wasp.* With our vastly superior shipbuilding facilities, we have been replacing our losses so rapidly that Japan can never again hope to catch up with our carrier strength.

If headline readers puzzle over how many new carriers we are putting into the water, they can hardly be blamed. For the Navy is building or converting no less than four distinct types.

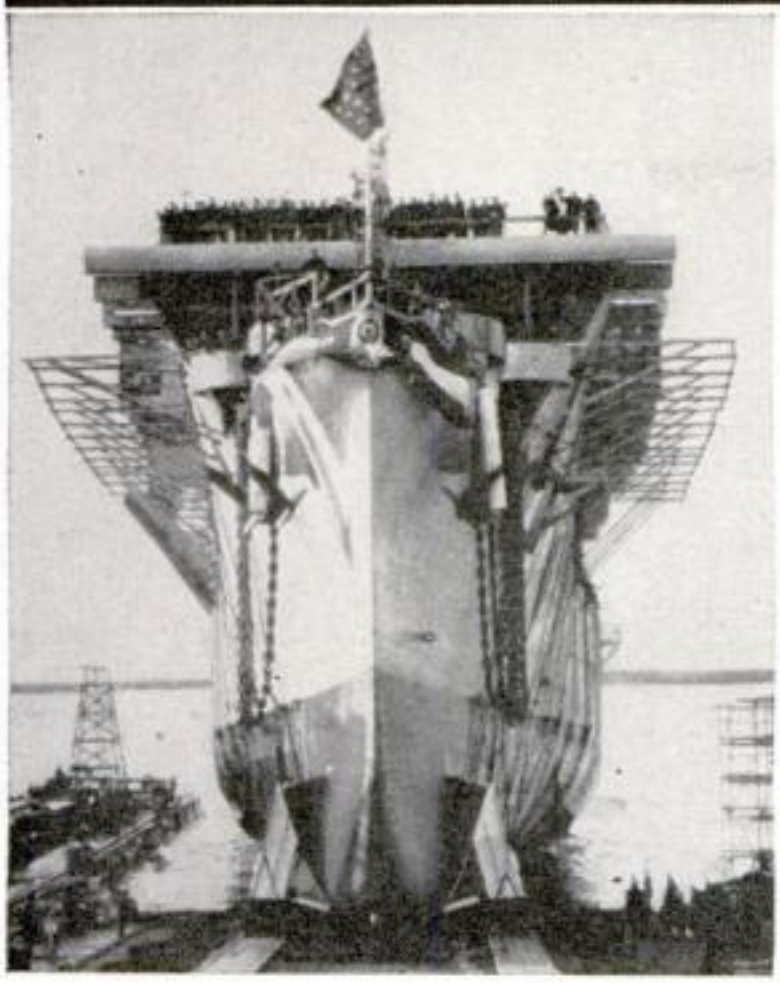
Big 25,000-ton vessels of the new *Essex* class now represent the Navy's preference for standard fighting carriers. Their excess of displacement over the previous 20,000-ton *Hornet* class may be used to increase cruising range by adding fuel-storage capacity—an important advantage in operat-

TAKE-OFF ORDER IS FIXED BY LENGTH OF RUN REQUIRED

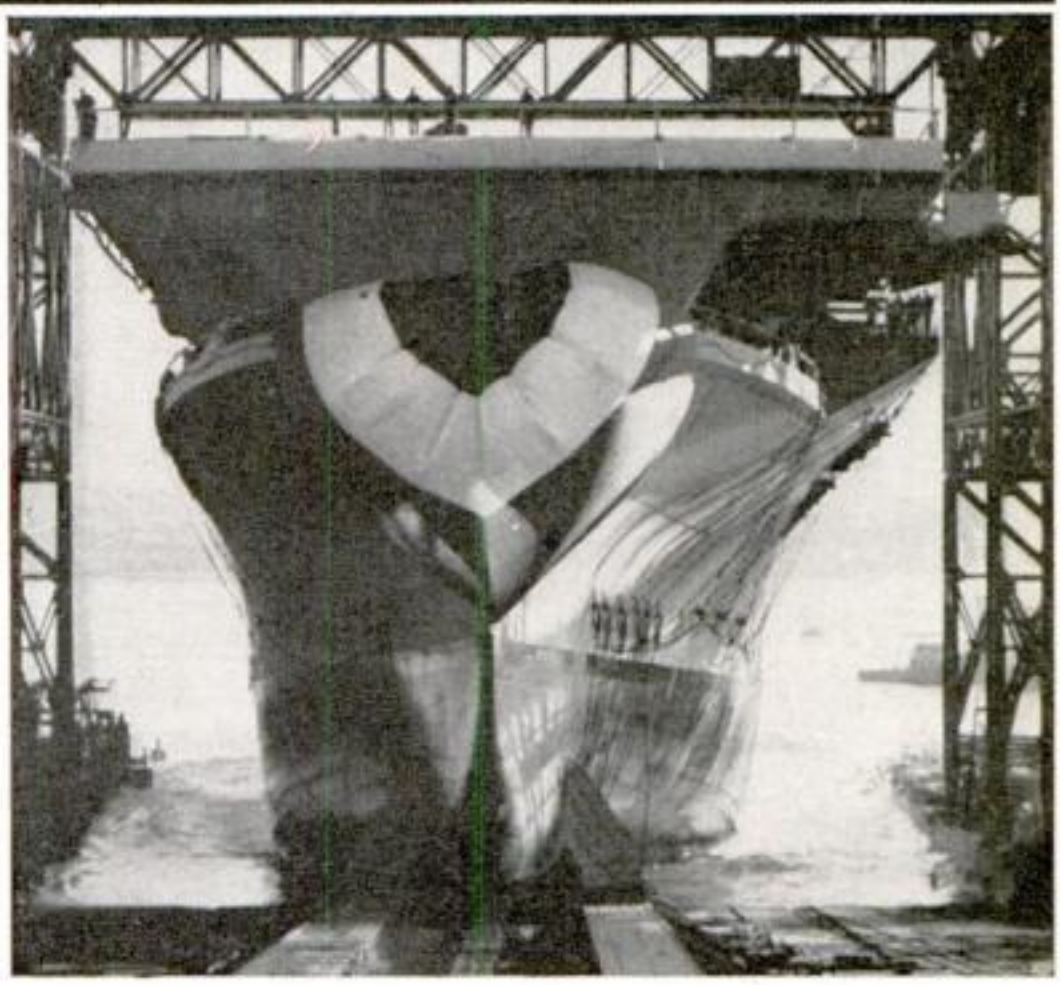


Spotting of planes on the flight deck and order of take-off are determined by the length of take-off run needed. Fast, light fighters are nearest the bow; the dive bombers are amidships, heavy torpedo bombers near the stern

A "POCKET CARRIER" . . . AND ONE OF OUR 25,000-TONNERS



"Pocket carriers," such as the *Belleau Wood,* above, are 10,000-ton cruisers converted into flat-tops in early stages of building

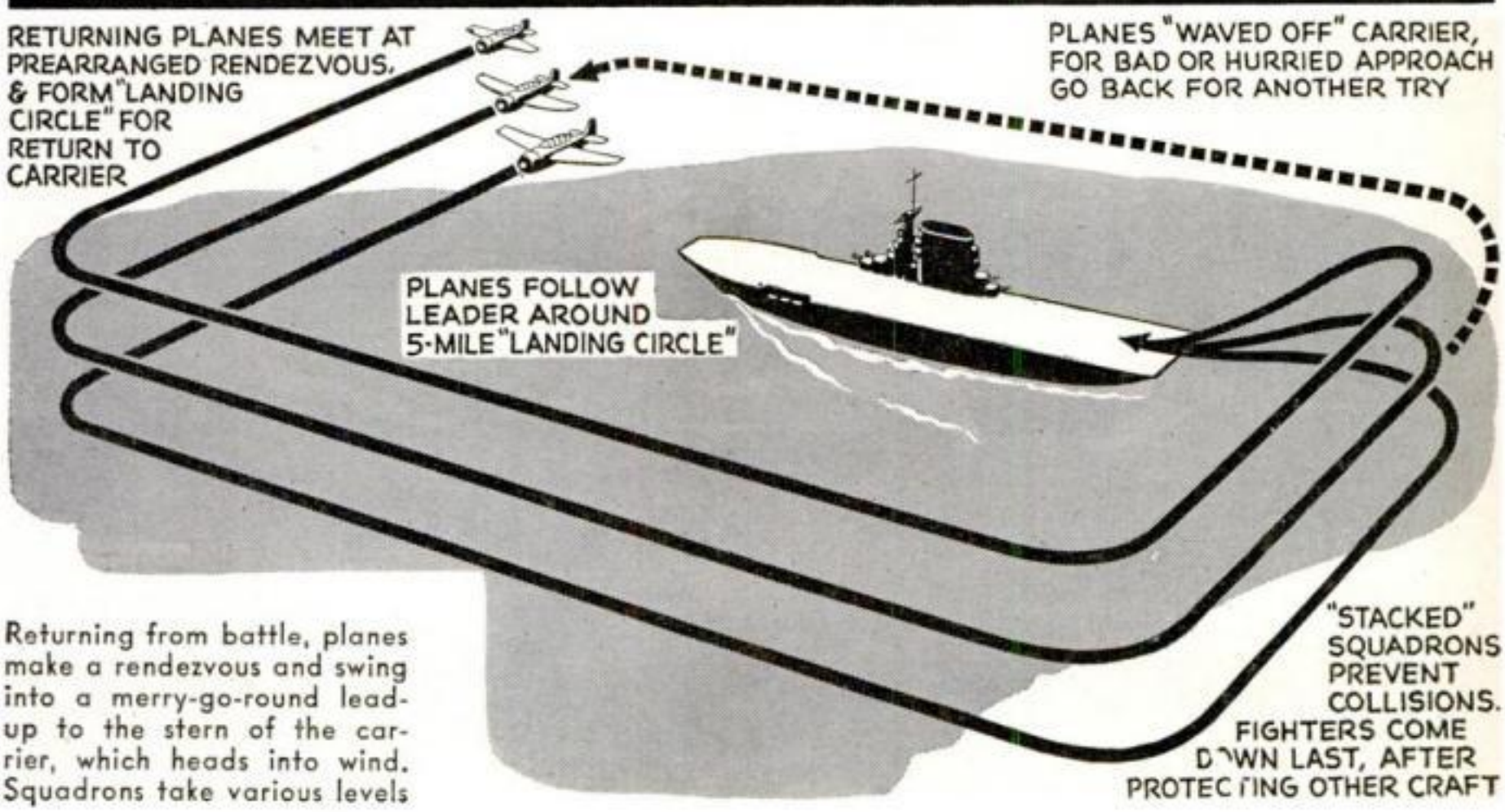


The *Bunker Hill,* shown here being launched, belongs to the 25,000-ton *Essex* class now favored by the U. S. Navy for new construction. Five have been launched; more are coming

ing far from home bases. Five of these ships have already been launched—the *Essex,* a new *Lexington,* the *Bunker Hill,* a new *Yorktown,* and the *Intrepid.* By the time these words are read, the first two will probably have been completed; and the second two should be at least near completion. Many more are building, in a vast construction program that is altering our carrier strength almost from day to day.

"Pocket carriers" of the *Independence* class, combat ships converted from 10,000-ton cruisers in early stages of construction, are probably the most controversial type among newcomers to our Navy. Critics declare that we need cruisers too badly to transform them into carriers. Limited size, they point out, reduces the small ships' usefulness as carriers, and rough seas would make take-offs and landings hazardous. Advocates of the pocket carriers counter with the assertion that carriers now perform scouting, raiding, and fighting missions as well as cruisers do. Japanese carriers just as small,

PLANES RETURNING FROM BATTLE USE "LANDING CIRCLE"



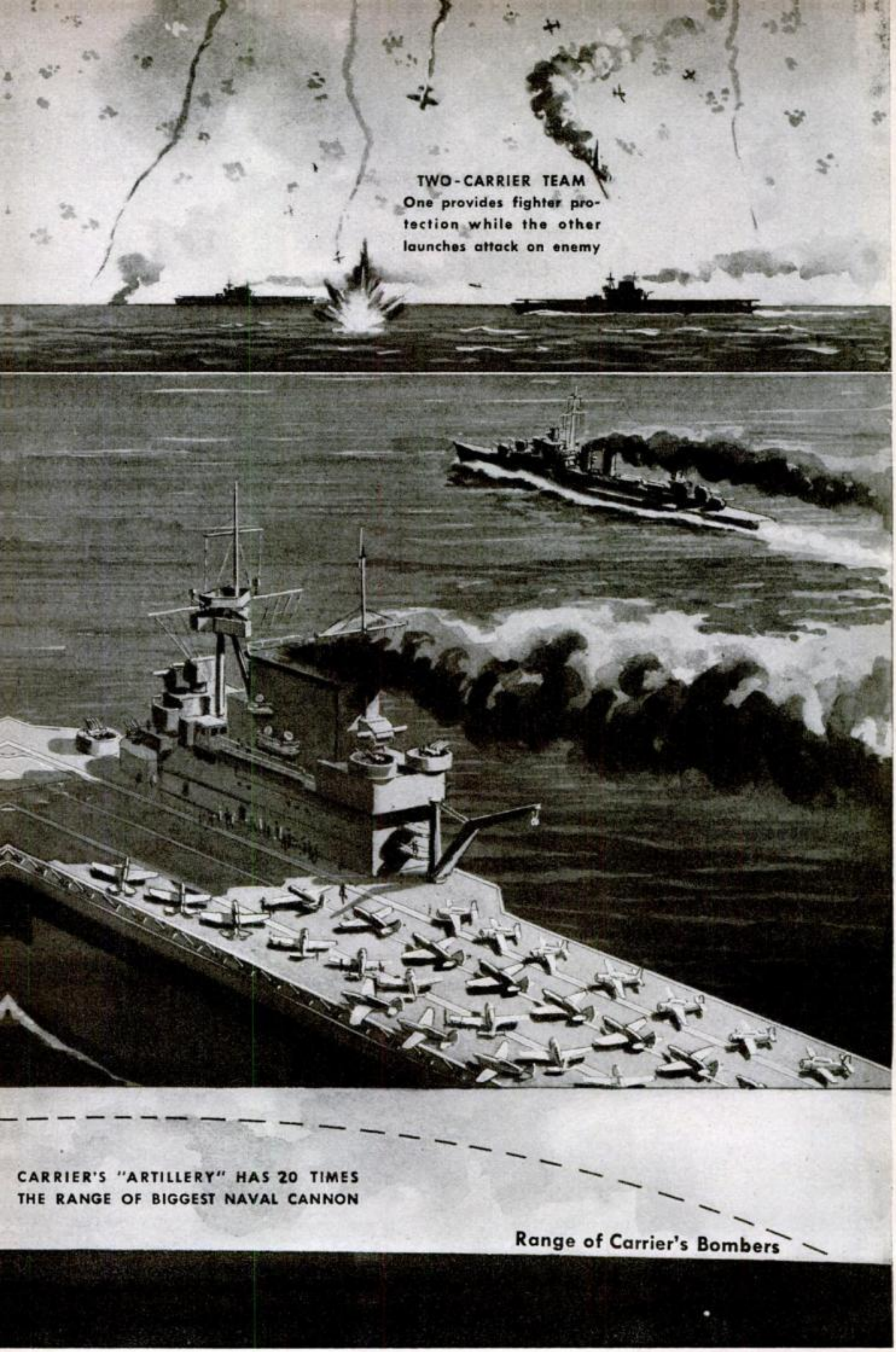
Returning from battle, planes make a rendezvous and swing into a merry-go-round lead-up to the stern of the carrier, which heads into wind. Squadrons take various levels

FERRYING FIGHTERS TO THE FRONT

Carriers can speed delivery of urgently needed land fighters. Uncrated and ready for action, the short-range planes ride the flat-top to a point within flying distance of their destination, then take off to finish the trip under their own power. "Hot" modern fighters manage the take-off from a flight deck without trouble

Drawings by B. G. SEIELSTAD

Range of Battleship's Guns

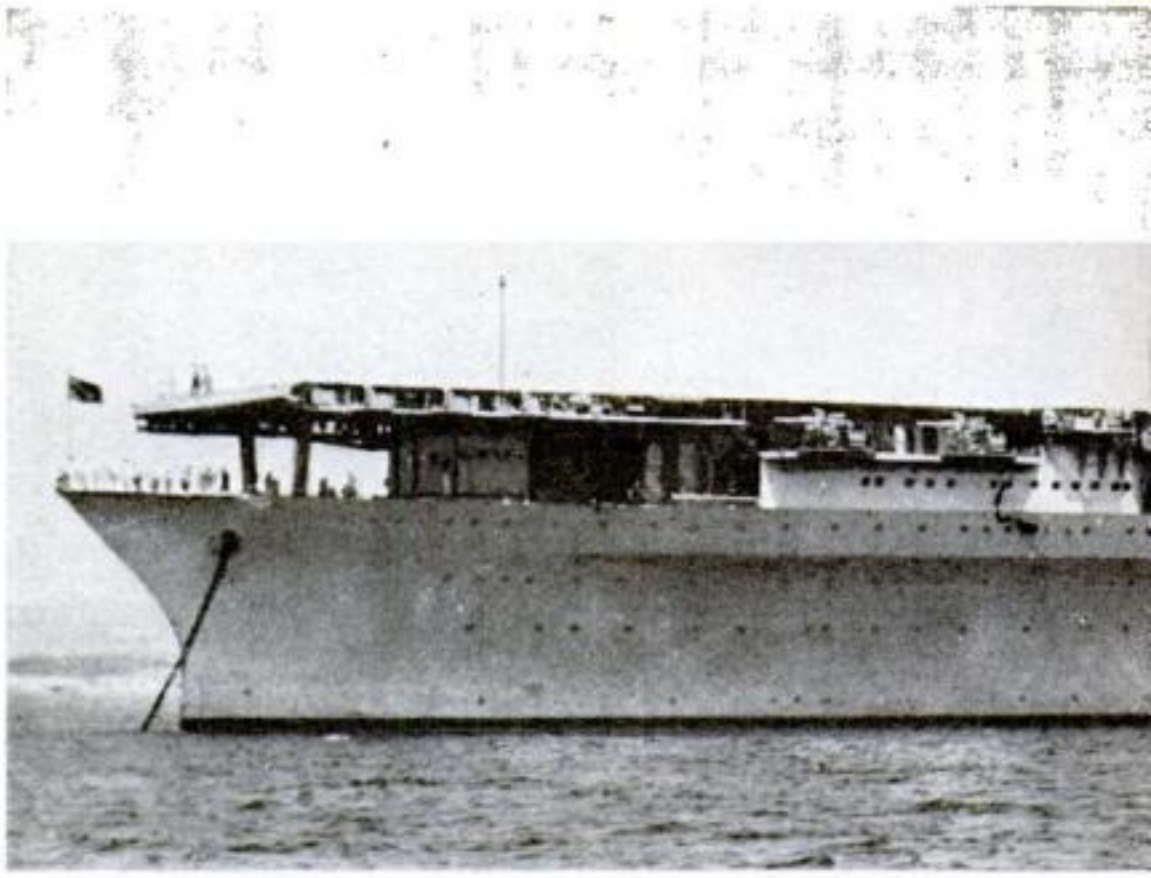


some equipped with anti-rolling gyro stabilizers, have been successfully operated. Limited size may be preferable to "putting too many eggs in one basket"; war lessons have not even yet demonstrated the ideal dimensions of a carrier, and we will be playing safe by building small ones as well as large ones. The midget craft can use smaller and shallower harbors. Finally—and this is the compelling argument—we need quickly all the combat carriers we can get, and the pocket variety can be rushed into service while big ones, which take longer to build, are still on the ways. Therefore, former cruisers launched as aircraft carriers include the *Independence, Princeton, Belleau Wood, Cowpens, Monterey,* and *Cabot.* At least the first of these should now be ready, with the others following in rapid succession.

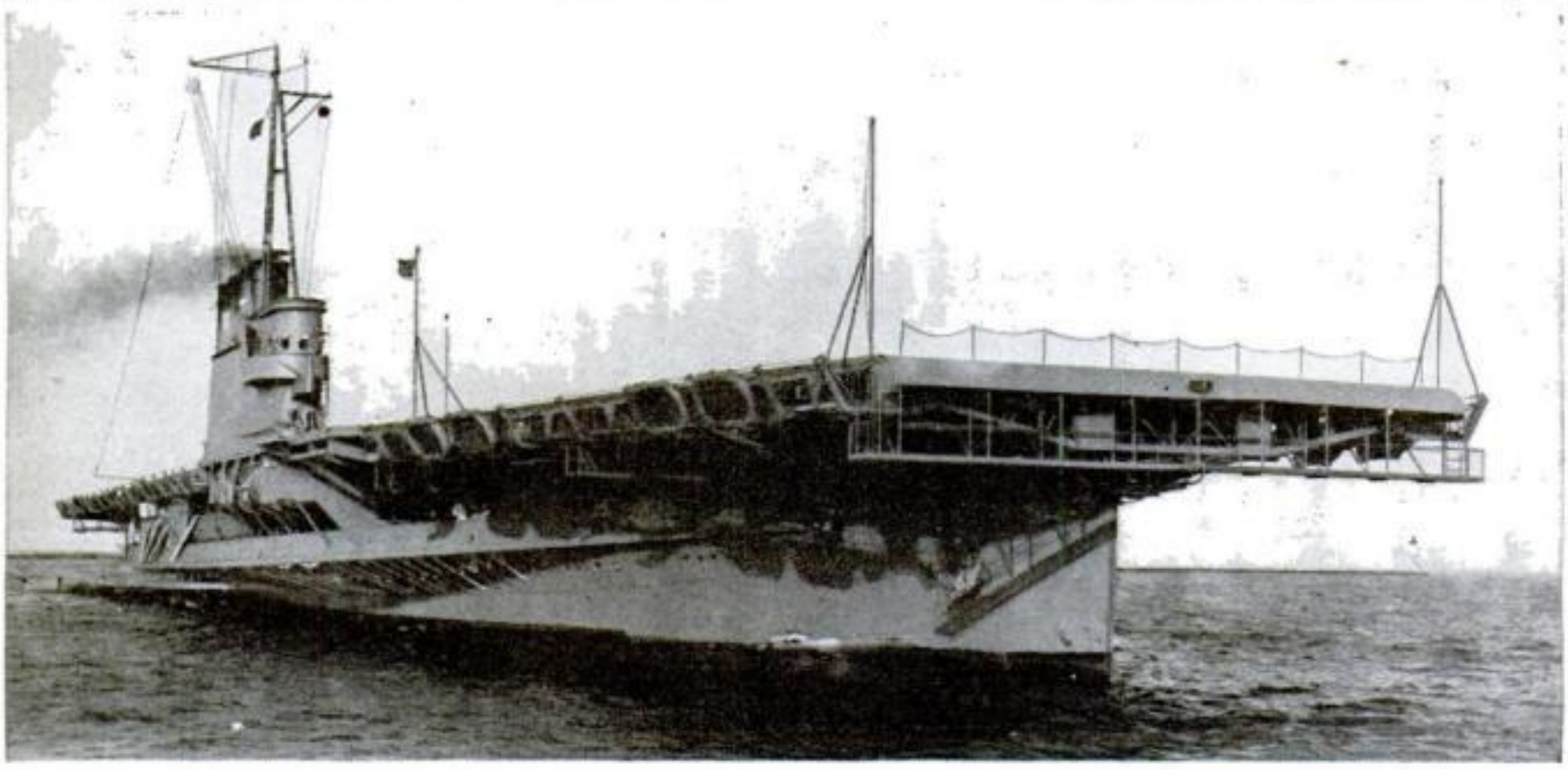
Following the Navy's successful experiment in converting the former merchantman *Mormacmail* into the U. S. carrier *Long Island,* in 1941, dozens of similar vessels have been placed in operation, according to Secretary Knox. Because of their limited speed, none of these ships are intended for combat duty. They serve excellently, however, to escort lumbering convoys, using their planes to spot and destroy enemy submarines—and releasing fast destroyers for other urgent missions. Converted merchant ships, or aircraft carriers built on the same lines, also may be used as "ferries" to transport other planes than their own. Uncrated, and ready for immediate action, a cargo of short-range fighter planes can be flown off the deck to its destination. Modern aircraft engines, approaching 2,000 horsepower, compensate for the restricted length of the take-off run. Successful experiments have also been reported with catapulting mechanism of special design. Scores of the "Woolworth carriers," as the British have nicknamed them, are in production.

To teach personnel how to man the mighty

FUNNELS present a problem in carrier design. The U.S.S. *Ranger* has three on each side, hinged to swing outboard horizontally, as shown below, when planes are taking off

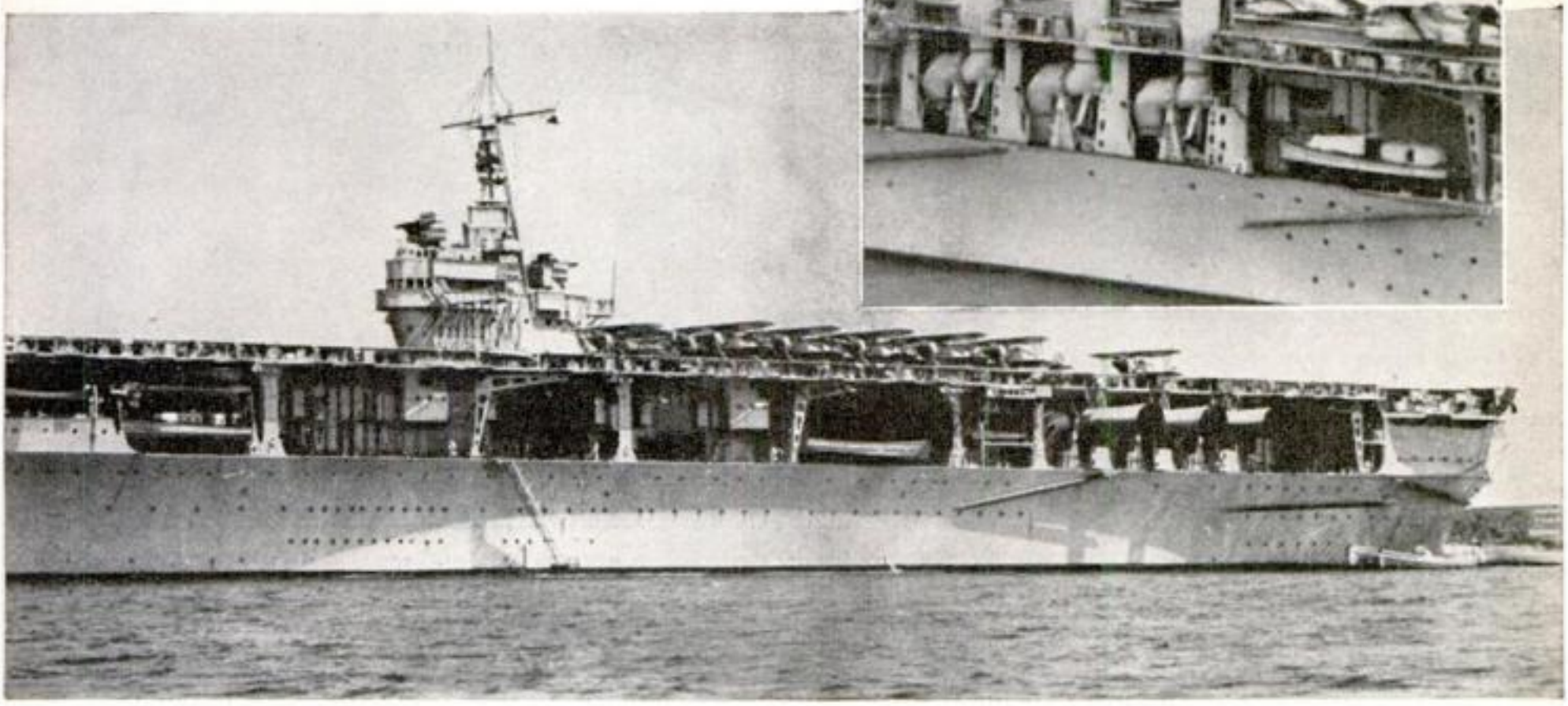


EXCURSION BOAT SERVES AS A CARRIER FOR TRAINING . . .



Side-wheeler excursion steamers on the Great Lakes have been converted into carriers for training use. This is the *Wolverine,* first vessel of the type. A second, the *Sable,* has recently been commissioned

Inset at right shows them in normal position. On most modern carriers, however, funnels are joined with superstructure in "island" at side

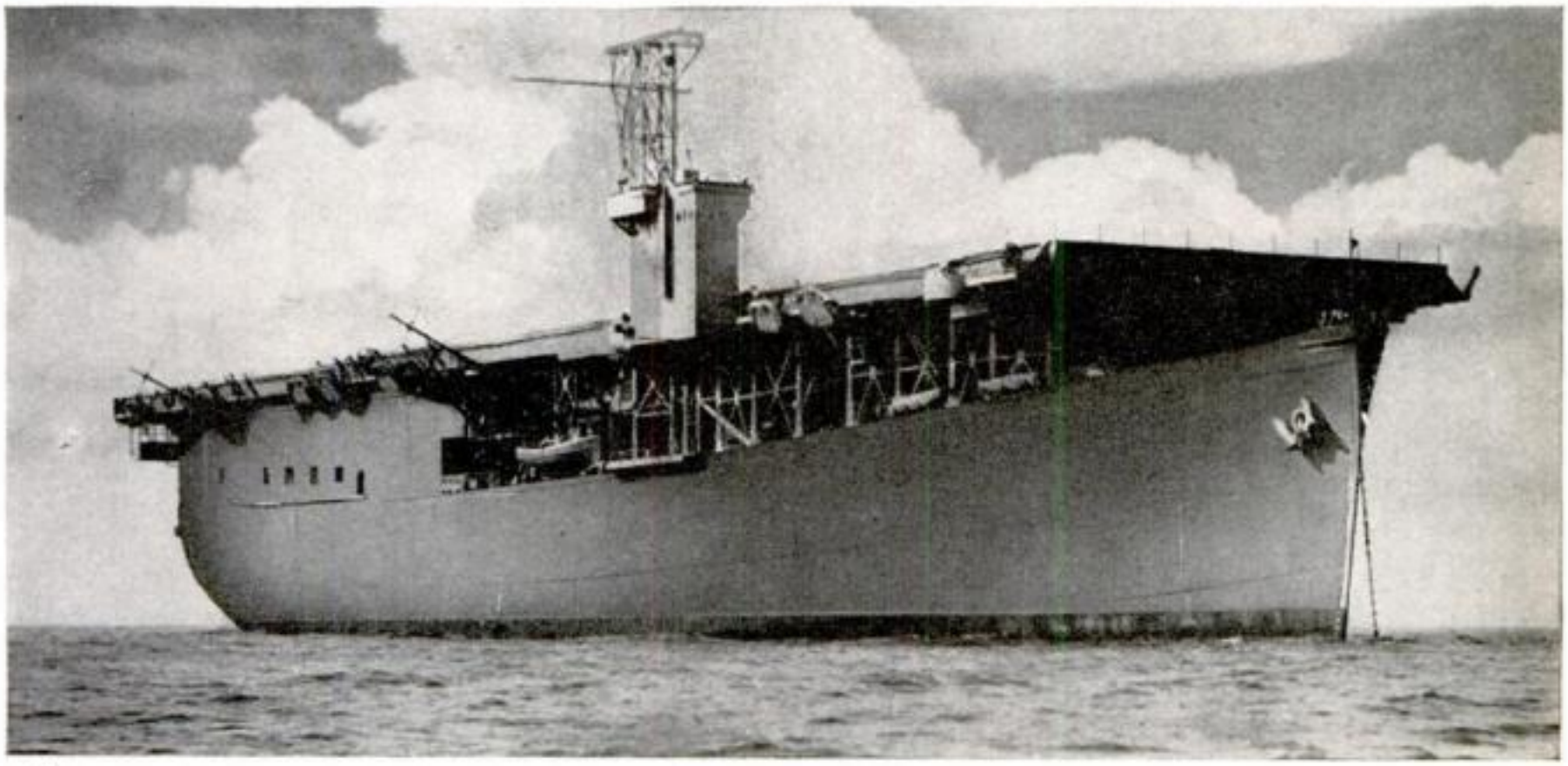


carrier fleet we are building, the Navy has placed special training carriers into service. Two of them, the *Wolverine* and the *Sable,* have the distinction of being the world's only side-wheeler aircraft carriers. They are operated on the Great Lakes, where they once were excursion boats.

Suppose a raw recruit sets out to learn everything from the ABC's to the fine points in the design and tactics of aircraft carriers. Here are some of the things he finds out:

Because of its dual function as a warship and as a floating airport, a standard carrier has a complement of 2,000 to 3,000 officers and men—more than serve aboard any other man-of-war. Its mighty power plant drives it through the seas at higher speed than that of any but a few of the most up-to-date destroyers. The world's largest carrier at this writing—the 888-foot, 33,000-ton U. S. S. *Saratoga*—greatly exceeds the length of a battleship of our new *North Carolina* class, and nearly matches it in tonnage. "Fire power" of an *(Continued on page 212)*

WHILE A CONVERTED MERCHANTMAN HELPS GUARD CONVOYS



The *Long Island,* formerly the S.S. *Mormacmail,* was our first experiment in converting merchantmen into carriers. Not fast enough for combat with the fleet, such vessels give convoys protection against subs

PILLBOX DESTROYER

In the 81-mm. mortar our Army has a handy weapon for smashing enemy strong points to clear the way for advancing riflemen

Photographs by William W. Morris

Big brother to the 60-mm. mortar which the Army uses principally as a machine-gun destroyer (P.S.M. Oct. '42, p. 56) is the weapon shown at right. In a well concealed spot, two men of a seven-man team get the mortar ready for action. While one aims the piece, another crouches alongside waiting to drop a charge into it

SEVEN MEN HANDLE THE MORTAR. FOUR CARRY PARTS AND SIGHTS . . .

Commanding the seven-man squad is a sergeant who carries the sight for the mortar, firing tables, compass, field glasses

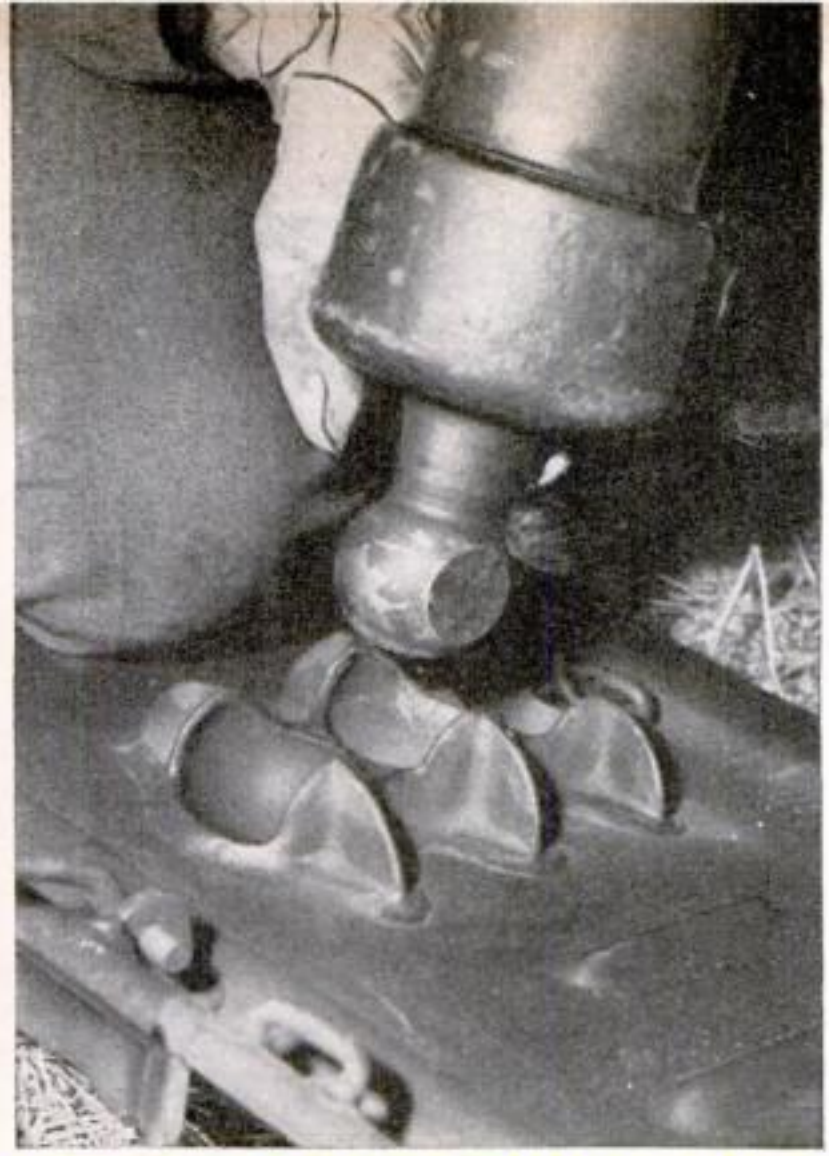
No. 1 man carries the bipod which supports the barrel, and aims the piece. Strapped-on shoulder pads help to cushion his 46-pound load

In charge of the business end of the weapon—the mortar itself—is No. 2 man, who takes over as the loader once the piece is set up and aimed

SQUAD LEADER

No. 1

No. 2



IN A FEW SECONDS, THE PIECE IS ASSEMBLED AND PUT INTO ACTION

The spherical projection at the base of the mortar barrel is placed in one of these three seats in the base plate and then locked by being turned 90 degrees. Projectiles are fired by adjusting the propelling charge, removing the fuse's cotter pin, and letting round slide down the barrel until it strikes the firing pin

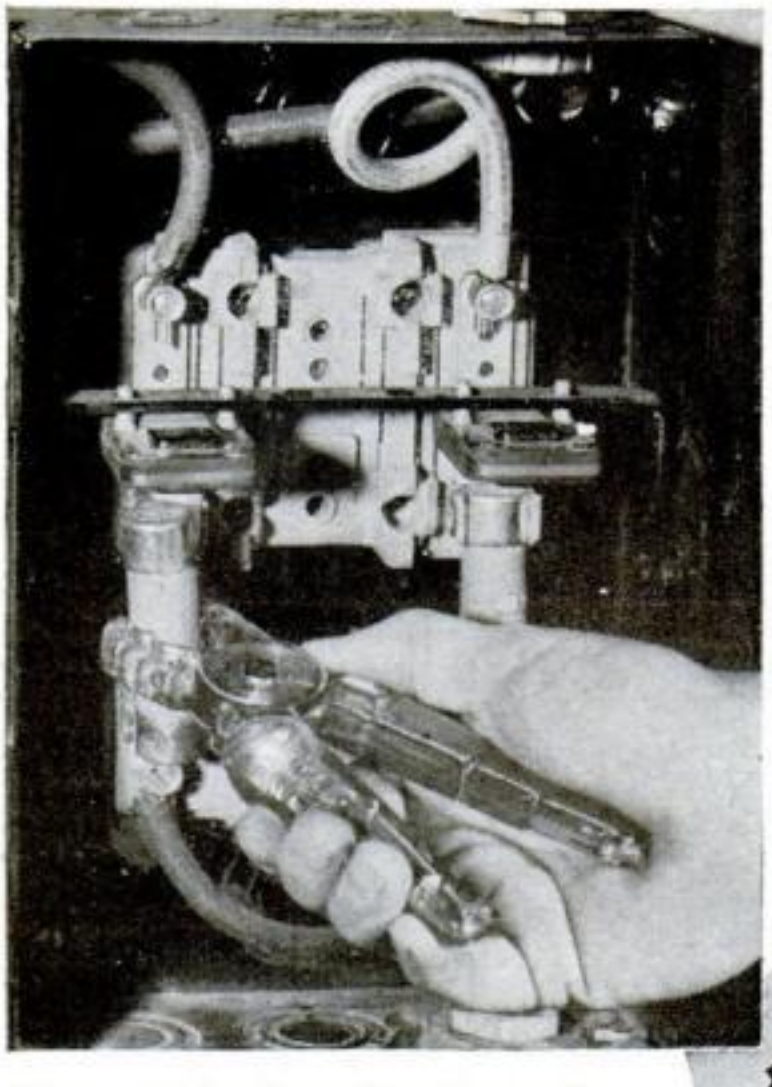
Here the No. 2 man is inserting a round into the mouth of the mortar while No. 1, having lined up the piece, ducks away. Squad leader, lying on the crest of the embankment, waits to observe the result of the fire. Depending on the weight of the projectile as well as the adjustment of its propelling charge, this mortar has a range of 100 to 3,300 yards. As a smooth-working team, No. 1 and No. 2 men can pump projectiles at the enemy at the rate of 35 a minute

. . . THREE, ARMED WITH RIFLES, CARRY SHELLS

The M6 aiming stake and the base plate, to which bottom of mortar is attached, are carried by No. 3 man. The plate weighs 45 pounds

No. 4, 5, and 6 men carry ammunition. Equipped with rifles, they also have the important job of covering their comrades while they work the mortar

Because the men in the squad must act as their own pack horses, they wear shoulder pads to ease their burdens. The mortar itself weighs 44 pounds; mortar rounds (depending on whether they are chemical, smoke screen, or demolition projectiles) weigh from six to 11 pounds apiece



Above, device is used as fuse puller; upper right, as current tester

TESTING OUTLETS AND APPLIANCES is simplified with this transparent combination tester and fuse puller made by the Star Fuse Co., of New York. Terminals in the handles (above) permit a quick check on base receptacles and circuit boxes by means of a 10-watt carbon lamp set in the clear plastic tool. The jaws can remove defective fuses (left) as large as 100 amps. One-hand action eliminates possible shock.

NEW Tools

GOGGLE-CLEANING STATIONS, made by the Mine Safety Appliances Co., Pittsburgh, can be installed in accessible locations to encourage workers to keep their lenses clean and thus not impair their efficiency. By tapping an inverted vial, as shown, a cleansing and anti-fogging liquid is sprayed on the lenses. Drying tissues are pulled from the top.

AN AUTOMATIC RIVET INJECTOR that inserts rivets in their holes and enables the riveting to be completed without removing the tool from the work has been developed by Vultee Aircraft engineers. Besides reducing waste motion, the device prevents the loss of rivets. Additional man-hours are saved by a light tubing assembly which, suspended from a traveling counterbalance, joins the rivet gun and bucking bar to enable a woman to do the work that formerly required two men.

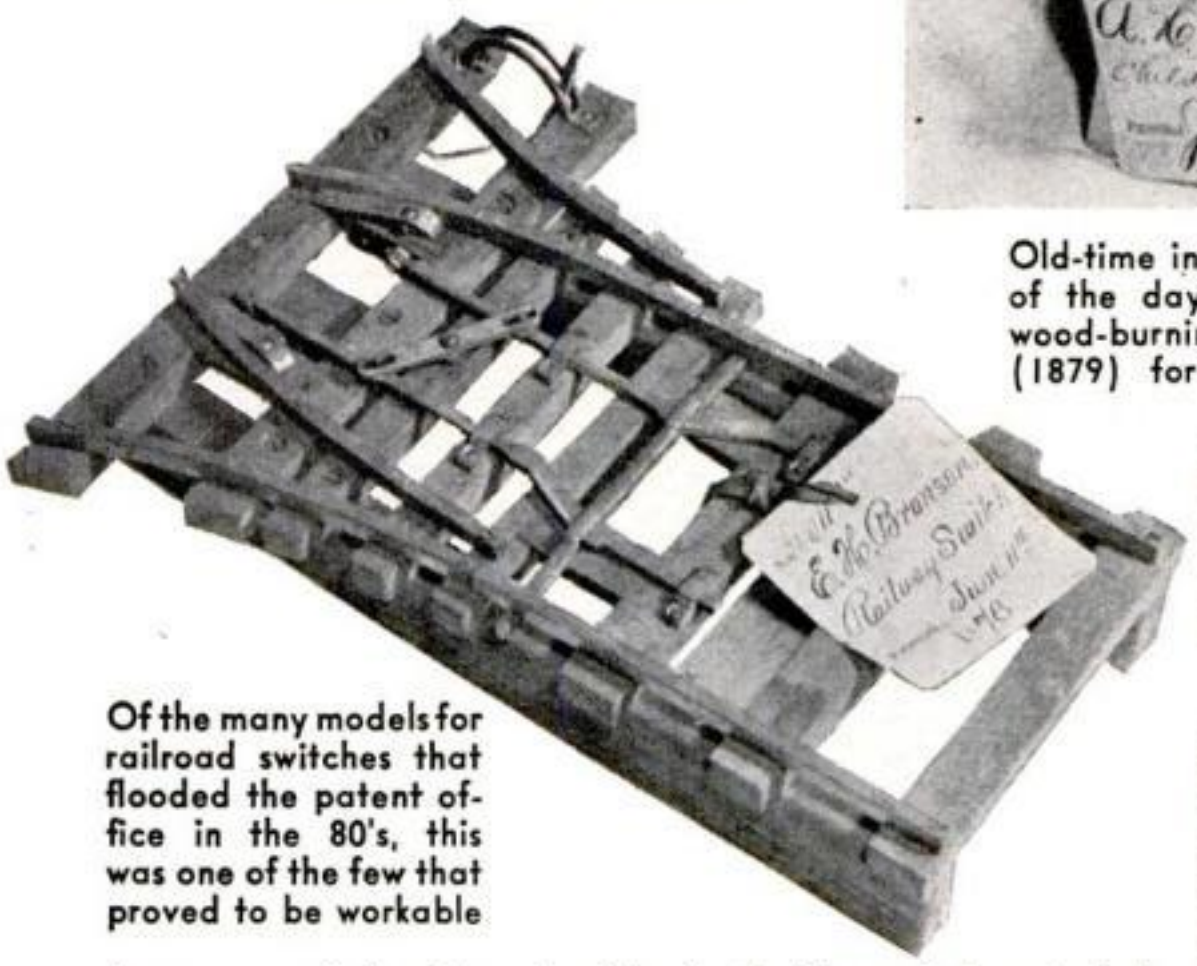
EASY READINGS of sixty-fourths of an inch on a machinist's scale are made possible with this sliding, plastic-lens magnifier, made by Leonard Engineering Co., Silver Springs, Md.

With the Inventors in the Nineteenth Century

Old patent models show how American ingenuity solved problems of the day

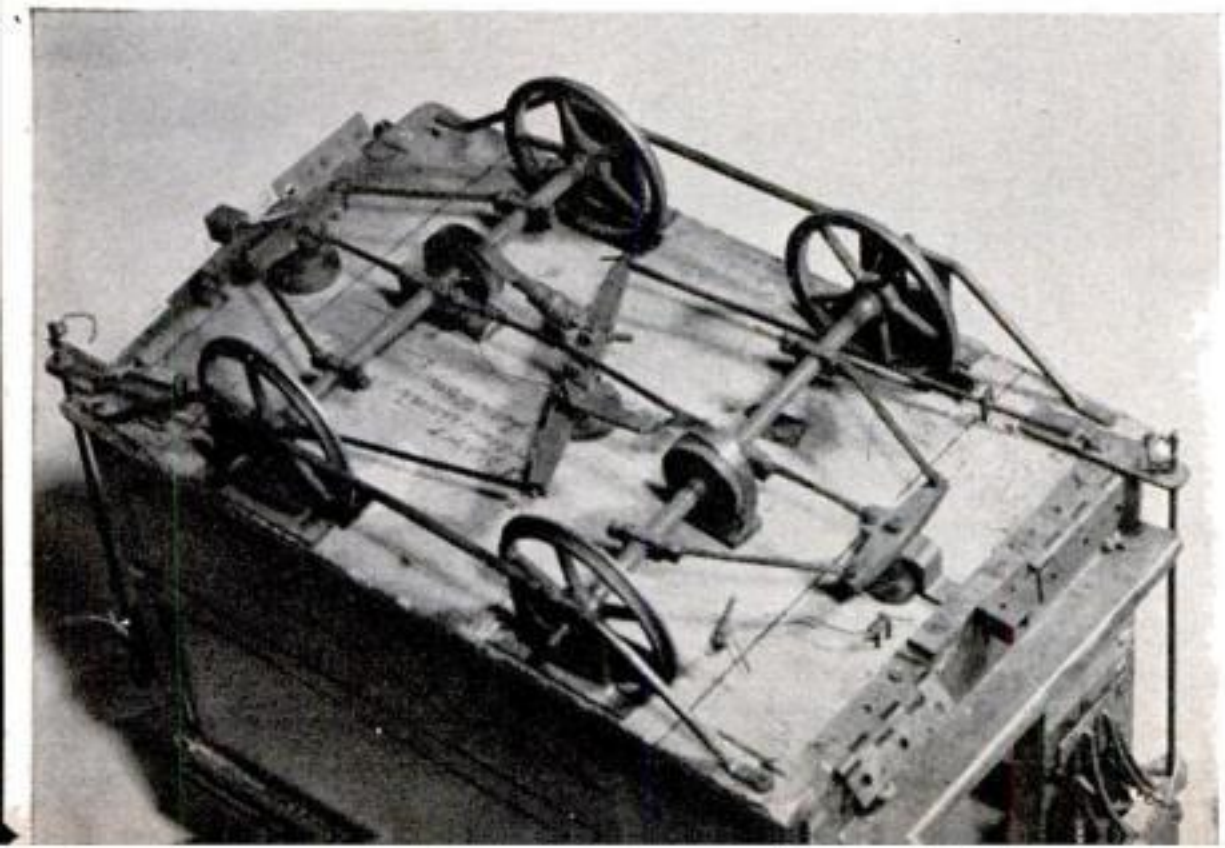
OLD patent models recently placed on sale in New York by O. Rundle Gilbert, of Garrison, N. Y., give a vivid picture of the way American inventiveness fulminated during the middle and latter part of the nineteenth century. The collection runs the gamut from sense to nonsense—from four-wheel brakes and milk dehydrators to automatic hat-tippers for men and extension fire ladders with boxes in which to carry children. A few of the 200,000 items in the collection are shown here.

Old-time inventors attempted to solve some of the problems of the day with a child's "chair" (1870), left; a parlor wood-burning stove (1874), right; and a dressmaker's dummy (1879) for turning out the very latest thing in bustles



Of the many models for railroad switches that flooded the patent office in the 80's, this was one of the few that proved to be workable

Forerunner of the four-wheel brake is this model, patented in 1876, in which metal bands, operated from either end of a railroad car, could be tightened over front and rear axles

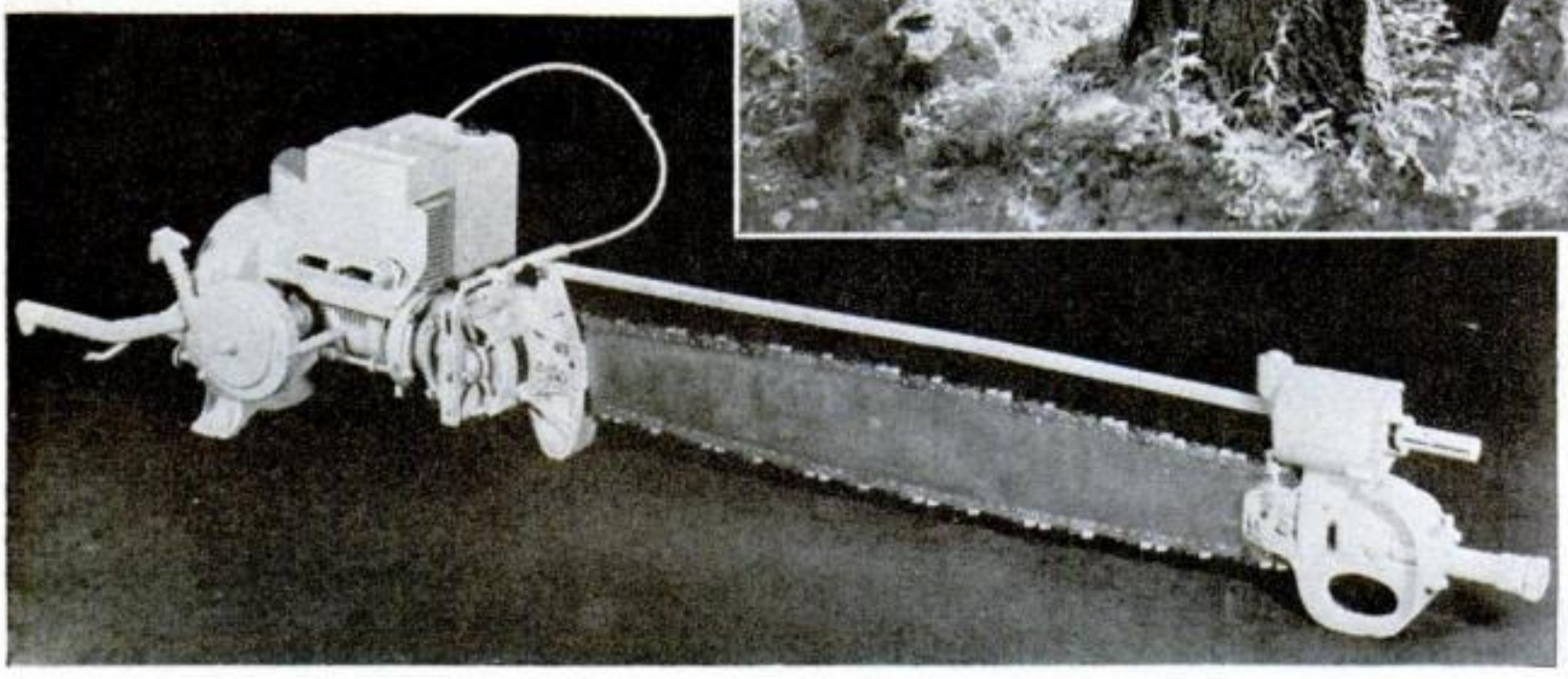


Lounging was as popular then as it is now, but not so successfully achieved — to judge from the stern-looking chair at the right which was designed to open out into a comfortable lounge, as shown above

Photographic Print Made with TNT

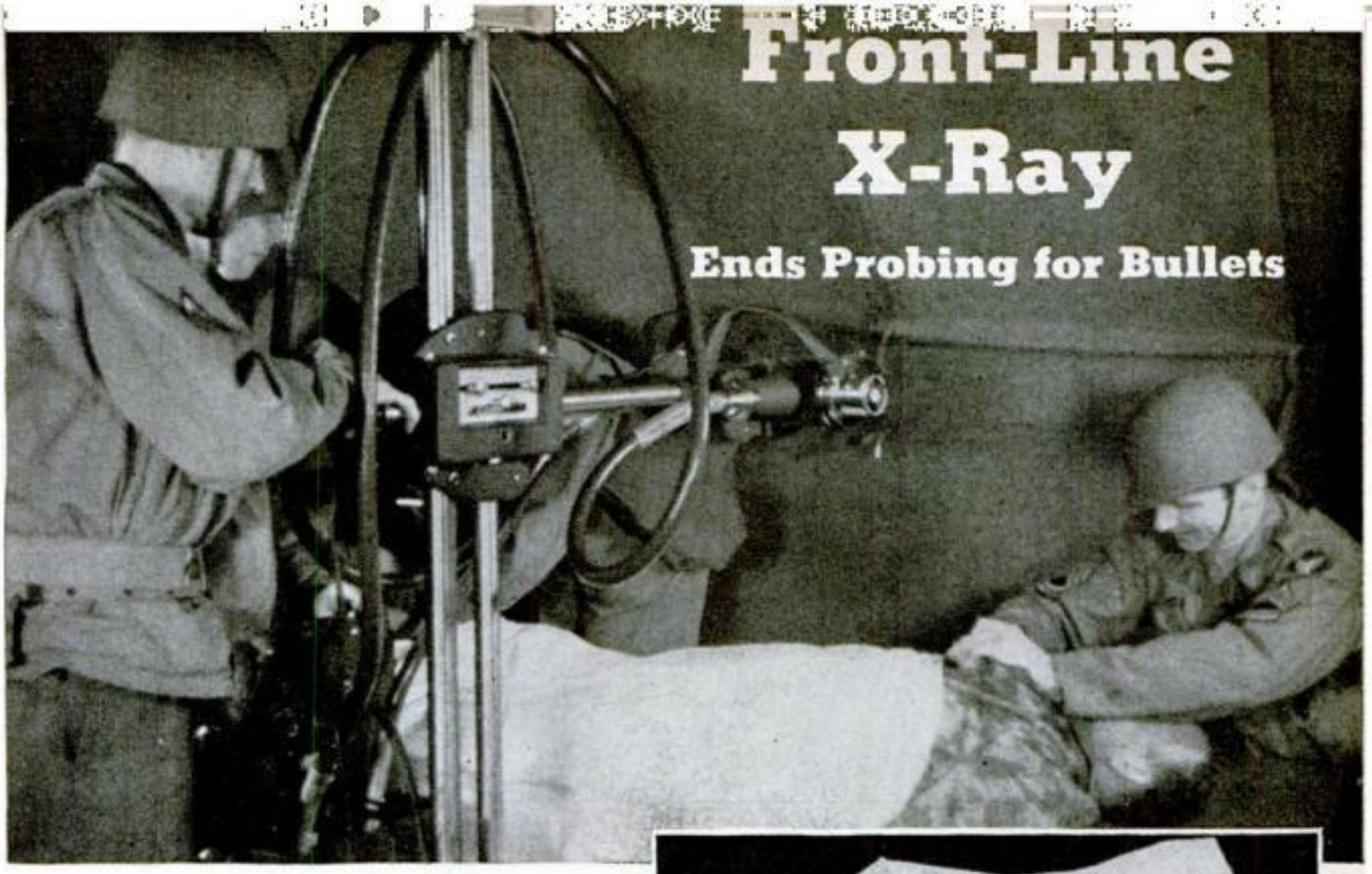
DEADLY TNT has been put to novel use in making this photograph of Major Lewis K. Kallmyer, commanding officer of the Plum Brook Ordnance Works in Ohio. While investigating the reaction of TNT to light, Dr. Walter O. Snelling, research director of the Trojan Powder Co., which operates the Government-owned plant, coated a sheet of paper with a thin layer of the almost-white explosive. Exposure to light turned it brown. When the portrait negative was held between the light source and the coated paper, the picture emerged. On the opposite side of the print, a faint pink image appeared, corresponding to the image on the face of the print. This pink coloring is thought to be due to an unknown compound of TNT and is being given careful study by explosives experts.

PORTABLE CHAIN SAWS that can cut through a 24-inch green oak trunk in 12 seconds are speeding the work of Army engineers in hacking out jungle airports and felling trees for tank traps. Made by the Kiekhaefer Corp., of Cedarburg, Wis., the saw is driven by an 11-horsepower outboard-motor-type engine. Weighing less than 100 pounds, it is easy to handle.



Front-Line X-Ray

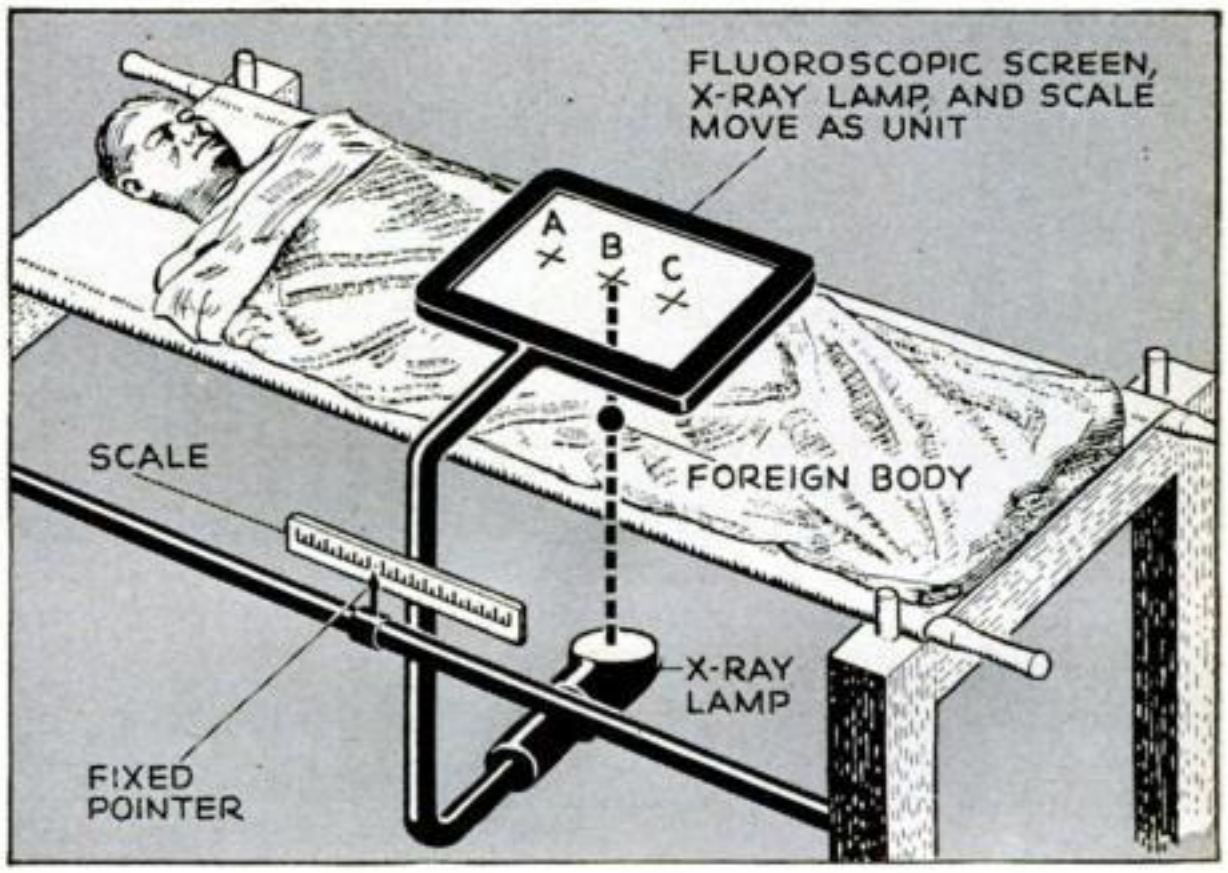
Ends Probing for Bullets



Within 40 seconds after this wounded soldier is placed on the field X-ray machine, surgeon will know just where to probe for bullets or shell fragments. Outfit travels as at right

PORTABLE X-ray field units that can be moved directly to the front lines by plane or jeep are saving lives on all United Nations battlefields. Developed by the U. S. Army Medical School and Picker X-Ray Corporation, they eliminate one of the principal causes of death from wounds—the added shock of surgeons' probing for bullets, shrapnel, or shell fragments. For one of these units, which weighs 398 pounds complete, not only locates the metal in 40 seconds, but at the same time also calculates its exact depth under the skin.

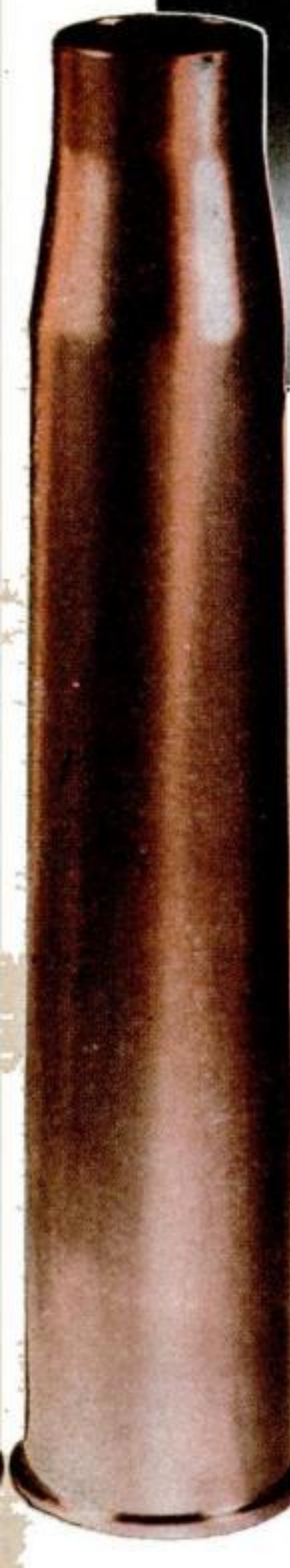
Within eight minutes of delivery in a combat area, an entire outfit can be put in operation by two nontechnical Army privates. A color scheme is utilized to facilitate quick packing, unpacking, and installation of the unit, and a small portable gasoline electric generator supplies it with the necessary power for the operation of the X-ray lamp.

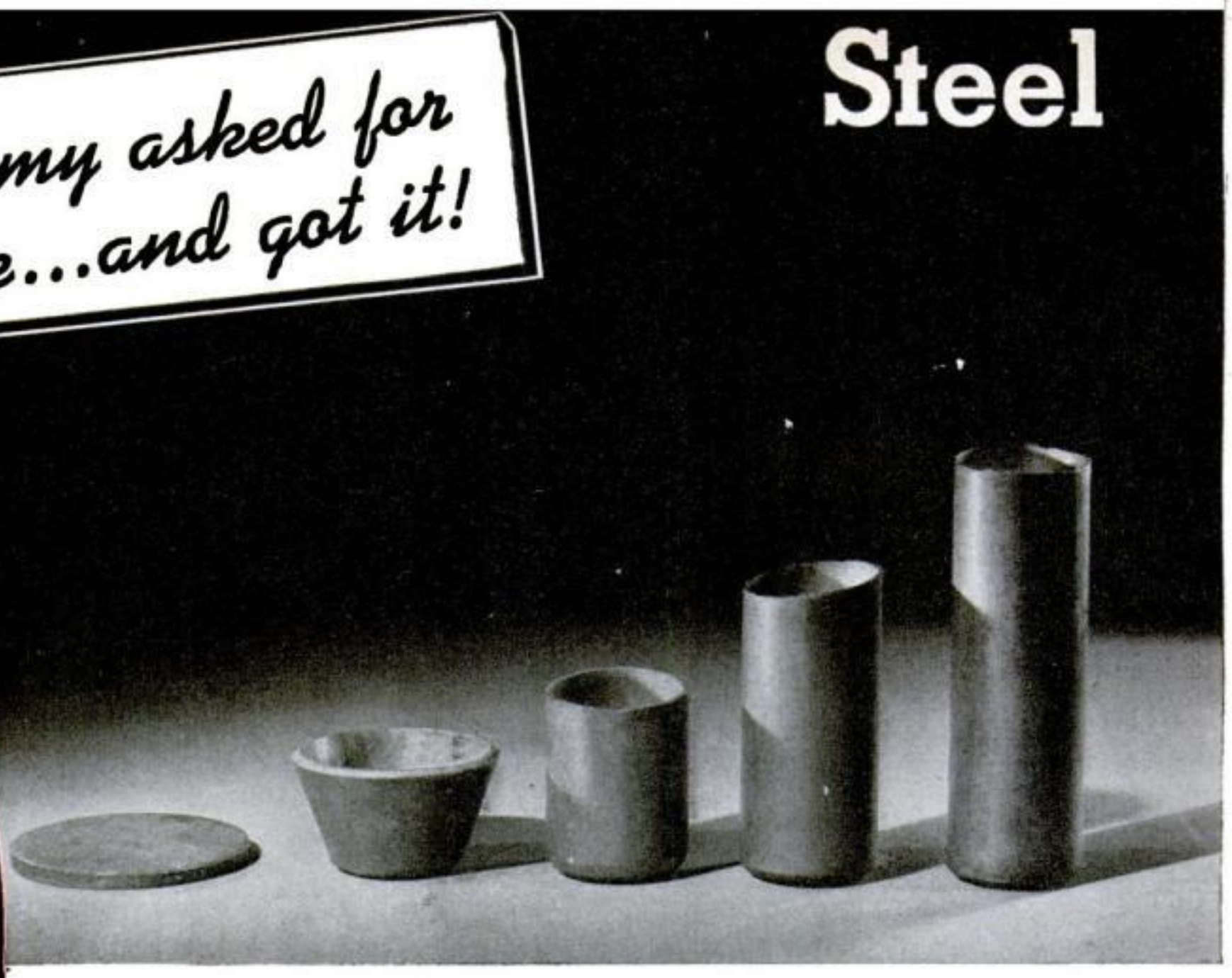


The distance the fluoroscopic screen and lamp must be moved to shift the image of the foreign body from B to A and C, on the screen, determines its depth below surface

The Army asked for miracle...and got it!

Steel





Cold drawing transforms the flat steel blank into a cylinder for a 57-mm. shell case

We needed millions of shell cases—and couldn't spare the copper to make them. This is the dramatic story of the Ohio plant that had the know-how to solve the problem, and of the revolutionary process by which it is done.

By JOHN H. WALKER

Photographs by William W. Morris

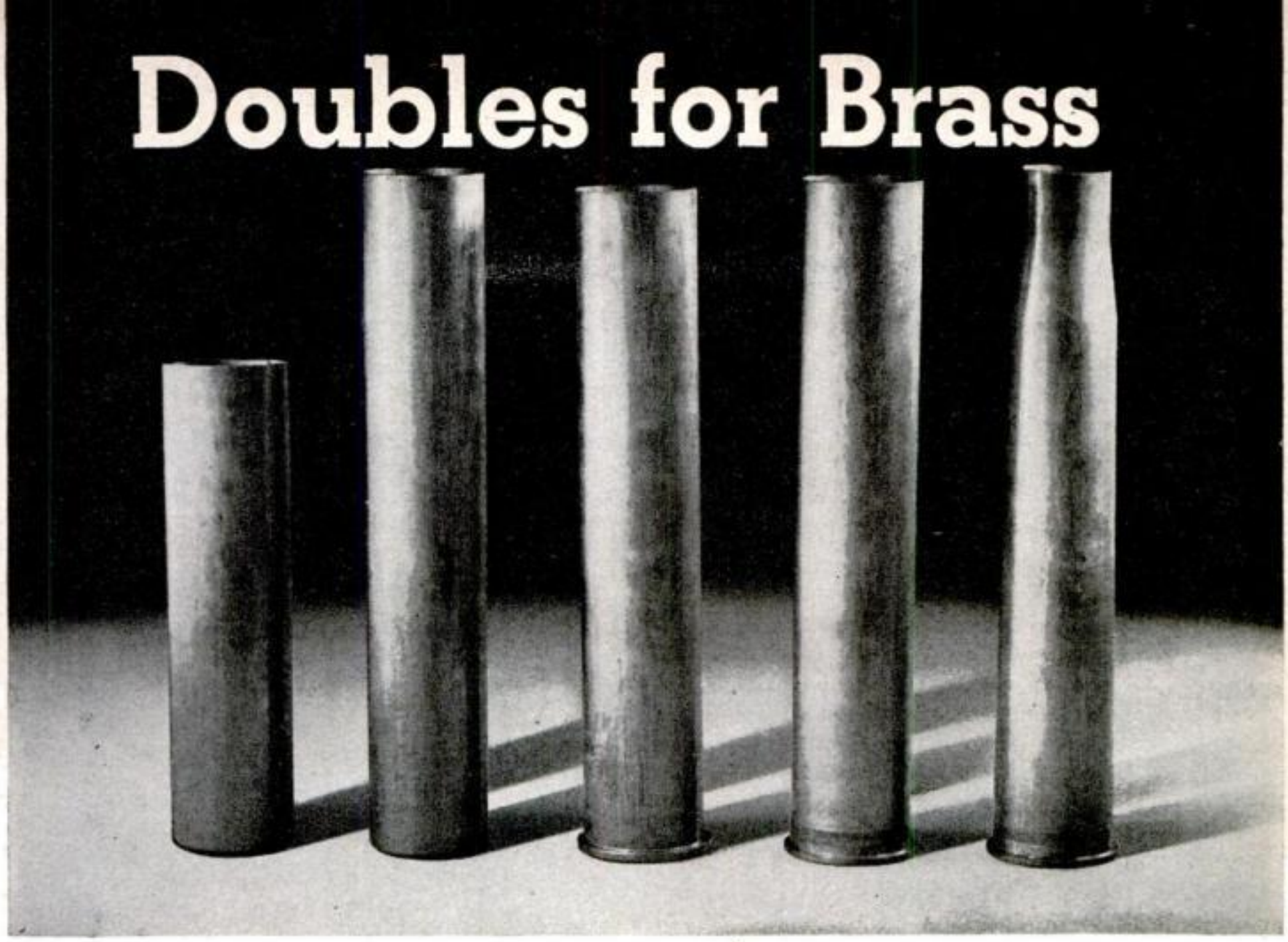
AUGUST, 1941, was a hot month in Cincinnati, as usual. C. L. Patterson, manager of the Corcoran-Brown Lamp Division of The Electric Auto-Lite Company, had plenty to worry about besides the heat, and one of his latest worries was a summons to go east to the Frankford Arsenal on the double-quick and confer with the U. S. Army.

Corcoran-Brown is a solid, unspectacular plant whose carefully made products have meant safety and comfort to many thousands of motorists and householders. At the time its main products were automobile headlights and refrigerator receivers. Those products were cold-drawn out of steel, and that is why the Army wanted to talk to "Pat" Patterson.

At Frankford, Patterson talked with a technician of long experience, Lieut. Col. L. S. Fletcher, and what Colonel Fletcher had to say was not cheerful news. This is what it added up to:

War was all too obviously approaching. We were marked as the big and final goal of Axis aggression. We were building our own defenses and meanwhile getting geared up to supply munitions to the other democracies. And the entire program was facing a desperate situation because of a shortage of copper, an essential component of brass, which, in turn, was the only satisfactory metal known for the making of shell cases. The copper supply had not declined; it was simply that circumstances were compelling us to raise our

Doubles for Brass



After being drawn to correct length, the case is machine-finished at the base and tapered at the mouth

sights on the entire program of ammunition making.

The ideal method for mass production would be to cold-draw the cases from a single piece of steel, Colonel Fletcher explained, but the verdict of industry and the Army's own experiments indicated that this was impossible. Patterson was compelled to agree that it seemed so. But, impossible or not, it had to be done.

Back in Cincinnati at the plant, Patterson did some high-powered thinking about the military shell case—a remarkably precise machine with numerous functions to perform. Basically it must serve as a powder container, a support for the projectile, and a carrier for the primer, which sets off the propelling charge. The complete assembly becomes a device known as one round of ammunition. This remains true for any shell from a .22 short to a bulky shell for a 105-mm. howitzer.

But the most vital active function of the shell case is to act as a valve, operating at extreme high speed and under terrific pressure far beyond that of any other mechanical valve known to industry. This period of valve action by the shell case in a typical automatic weapon is about 1/300 of a second.

When a shell is inserted in a gun, a certain clearance, perhaps 10 to 20 one-thousandths of an inch, is provided for ease and quickness of loading by the gun crew. When the round is fired, a tremendous gas pressure is liberated in the shell case within the gun's breech. The gun itself expands slightly; this is known to ordnance engineers as "breathing." And the shell case must expand enough to take up the clearance plus the gun expansion, and thus form a tight valve seal so that all the expanding gases will drive against the departing projectile, and none of them will seep around to "blow back" into the breech and injure the cannon or its crew. This expansion is called "obturation."

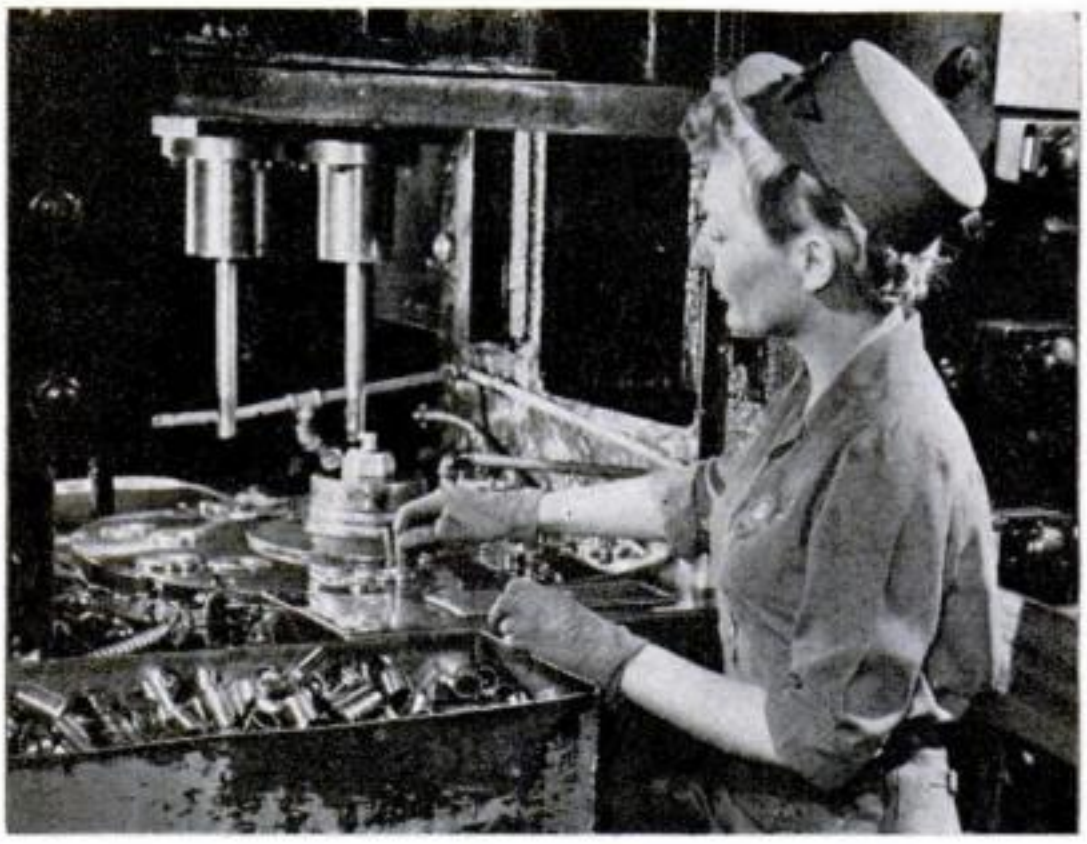
But then, like a well-behaved valve, the shell case must contract back to its original size, so that it can be quickly ejected from the gun and replaced by a fresh round ready for firing. This is important in any field-artillery operation; it becomes absolutely indispensable in a modern automatic aircraft cannon, in which shells are loaded, fired, and ejected at a cyclical rate of perhaps 600 times a minute.

Now, for highly technical reasons, brass does an almost perfect job of this. Steel, in normal circumstances, does not. Engineers have a technical explanation for the difference; they say that the modulus of elasticity of brass is 14,000,000 as compared

1 Cups formed from steel disks are loaded into a shuttle-feed press for the first of a series of cold draws, in which high-pressure steel plungers elongate the metal cylinders

2 Before another draw can be made, the partly finished cases must be washed and coated with a soapy solution, which serves as a lubricant and protects the dies during the stamping

3 Cold-drawing hardens the steel and successive draws would make it brittle and easily cracked. So between the early draws, the cases must be annealed in a gas furnace at around 1,300 degrees F. to restore needed elasticity



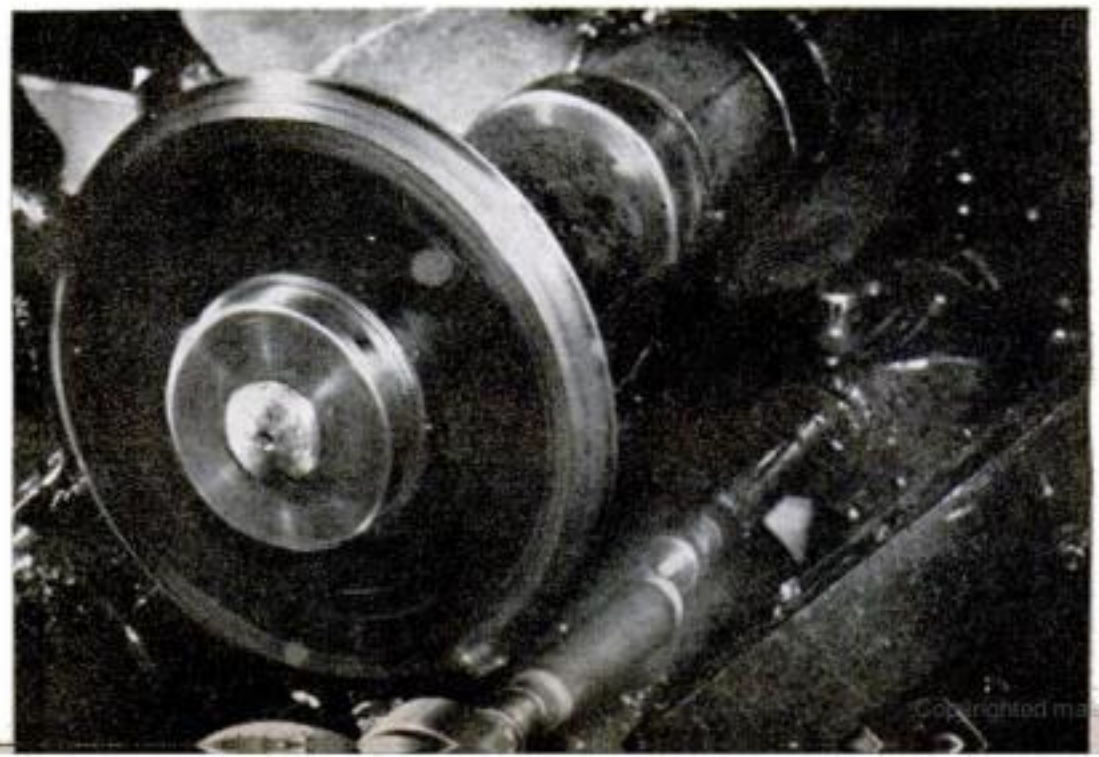
4 Girl operator loads cases into a dial-feed press for the second draw. Twin plungers of tool steel do the stamping. Women fill three quarters of the jobs at Corcoran-Brown, and operate whole lines of these automatic presses

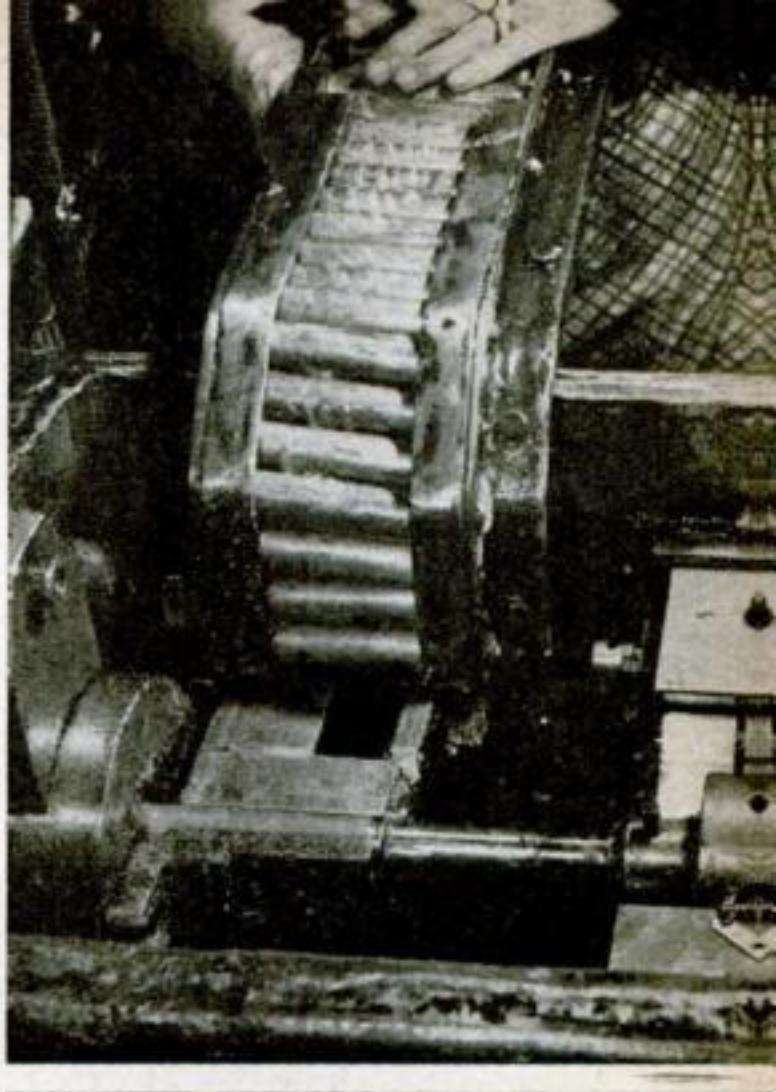
with 30,000,000 for steel. In laymen's language, brass is elastic enough to expand, but stiff enough to contract in the right degree. Steel is so elastic that it may overexpand, and then freeze or stick without contracting enough.

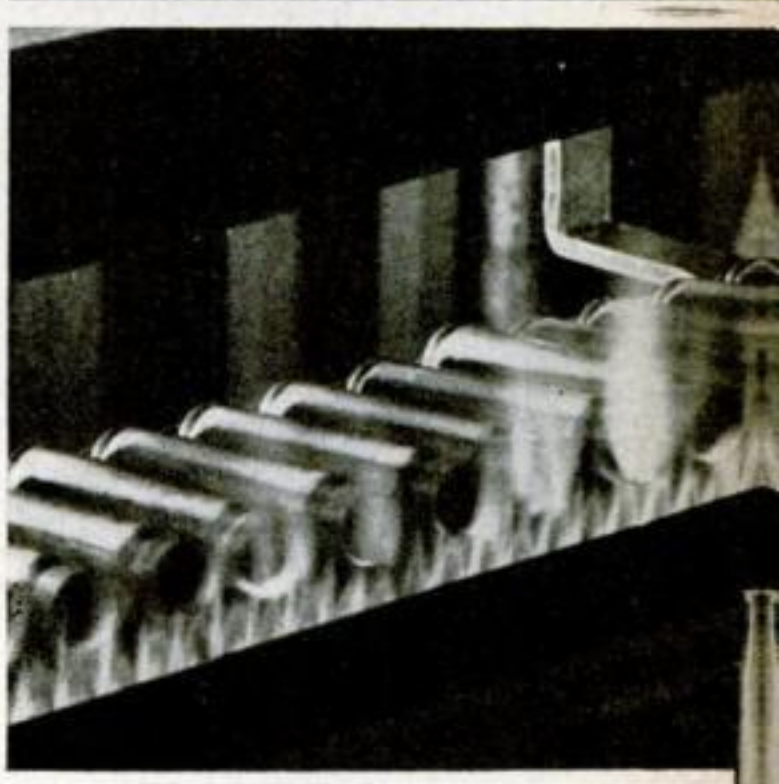
First of all, Patterson had to find out whether it was mechanically possible to draw a shell case out of steel. The best opinion and experience in the industry said "No." There was a kind of rule of thumb that cold drawing of steel could be done only in the ratio of three to one. That is, the finished part could not be much longer than three times its base diameter.

Patterson's staff licked that within a month. They *(Continued on page 206)*

7 Close-up of trimming machine, which cuts off the excess material at the case's mouth. Dimensions of each case must be controlled within a few thousandths of an inch to assure proper loading, functioning, and extraction. Final inspection has 13 gauge examinations





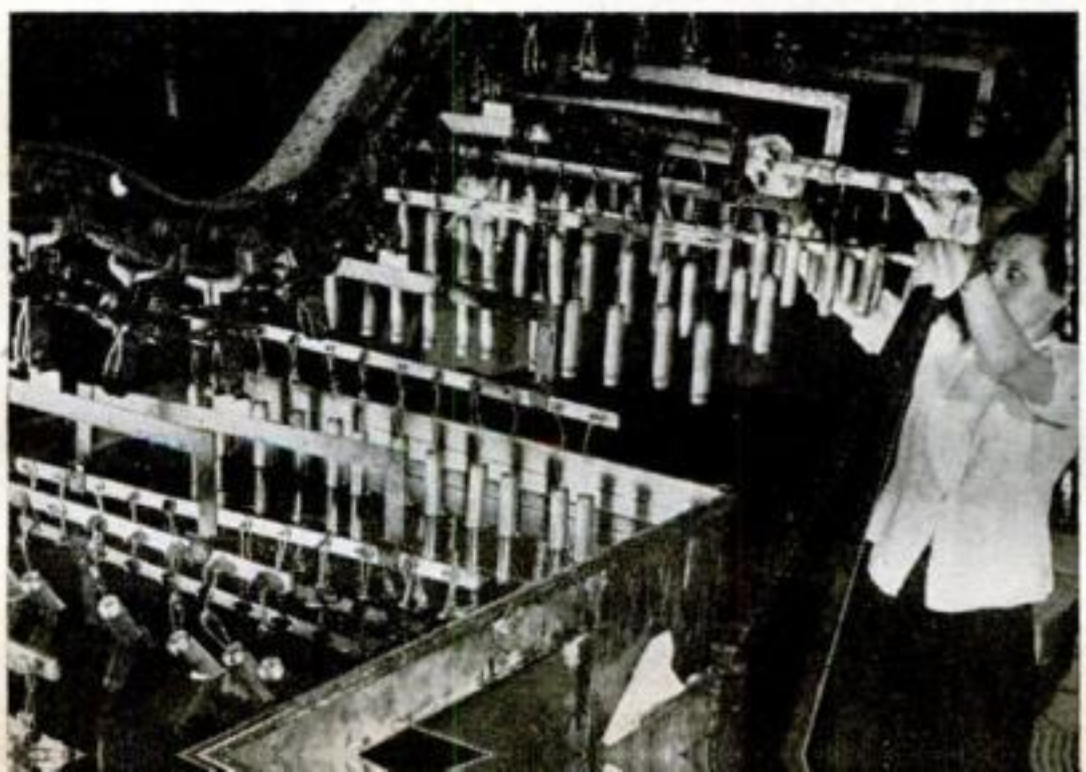


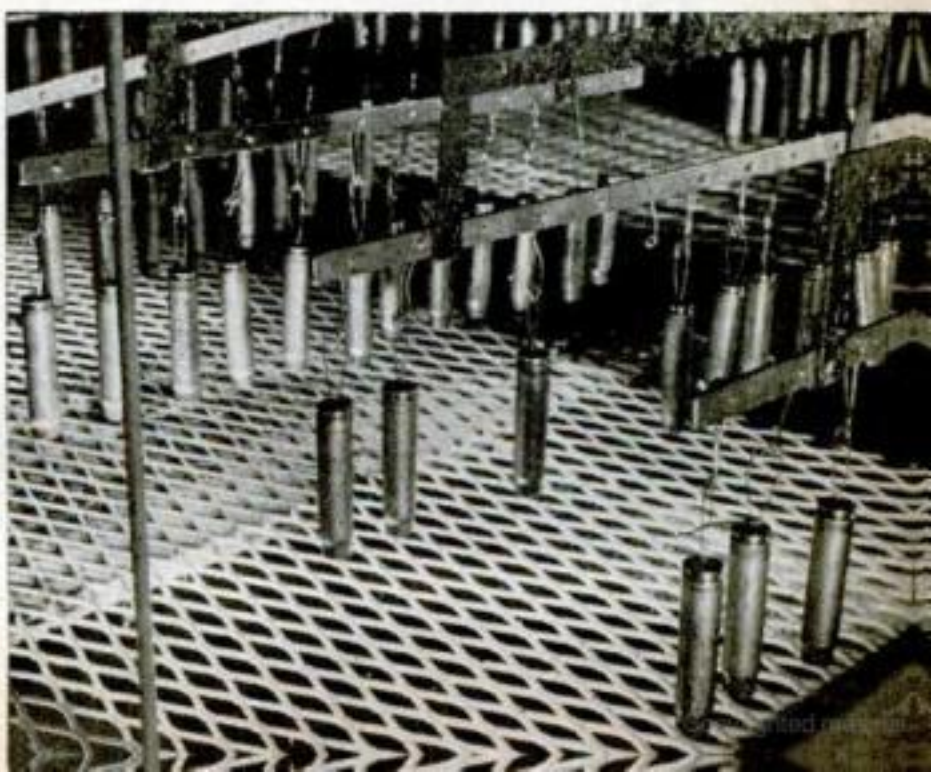
5 Final draw on the big 57-mm. shell case is done by this huge hydraulic press, whose plunger exerts some 40 tons of pressure on the metal piece. As a safety measure, the operator must step back and press switches with both hands to operate the plunger. An ingenious hydraulic system, built into the plunger, employs the final downward thrust of the press to strip the case off the plunger and then eject it downward to a conveyer belt below the machine. The hydraulic fluid also serves as lubricant in easing the shell case off the end of the plunger

6 At top, girl oils cases feeding into tapering machine. Gas flames (above) mouth-anneal a row of cases, so that the tapered mouth is slightly more elastic than the body of the case

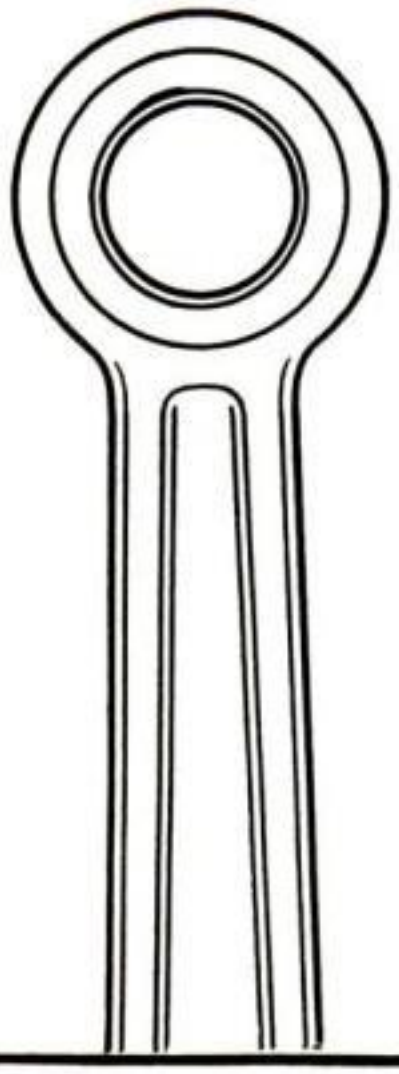
8 Final processing includes coating with phenolic varnish, which is then baked on to protect the case from rust or corrosion, and lessen the risk of sparking if the case strikes against other metal. Varnish saves copper by replacing the older type of protective plating

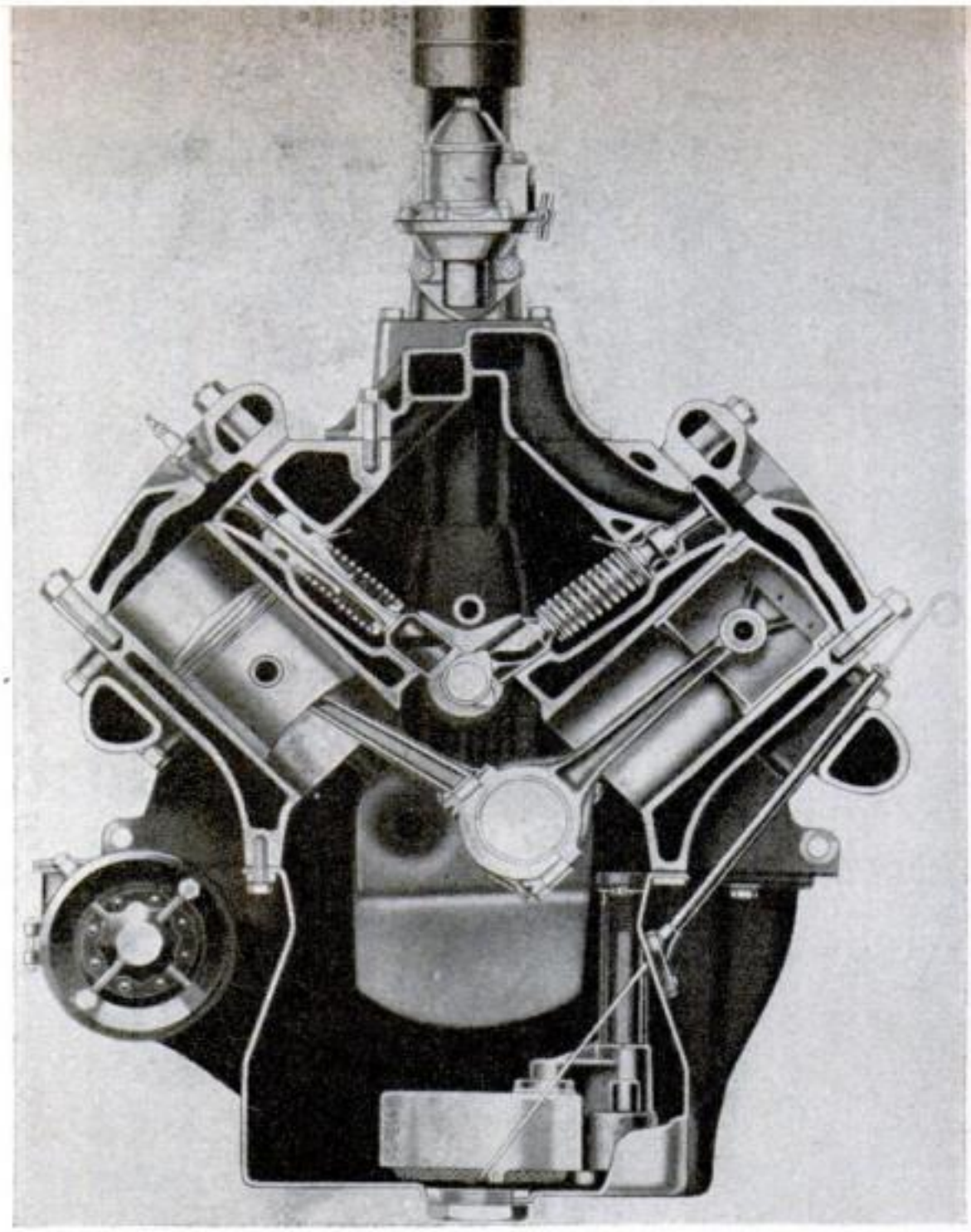
9 After dipping, varnish tends to collect in a bead at the case's mouth. To prevent this bead from hardening, the conveyer passes over a 130,000-volt "detearing plate" whose powerful electric field pulls off all the excess varnish





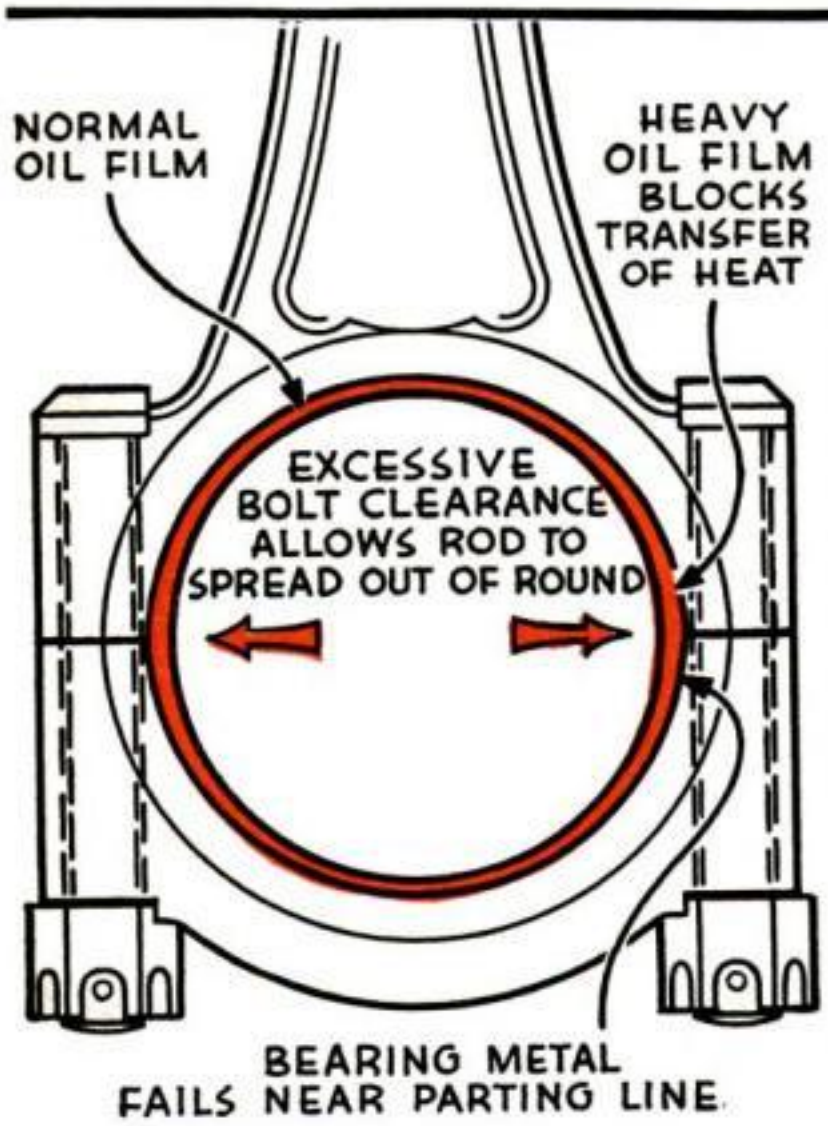
Both opposing connecting rods on the Ford V-8 rotate on the same "floating" bearing. The two rods ride the outside of the bearing, and the crankpin rides the inside





Are Faulty Bearings

CHECK THEM IF OIL PUMPING PERSISTS AFTER



By RALPH ROGERS

WHILE worn piston rings and defective valve guides are often the cause of excessive oil consumption, smoky exhaust, and a knocking engine, these troubles sometimes persist even when new rings and guides have been put in. In these days of high-speed, high-compression engines that use a pressure, or forced-feed, system of lubrication, it often will be found that the source of the difficulty is defective bearings. Worn, scored, or ill-adjusted camshaft, crankshaft, or connecting-rod bearings can make an engine miss or knock and cause low oil pressure, pre-ignition and spark knock, heavy carbon deposits, backfiring in the muffler, and generally poor engine performance.

There are three types of main and connecting-rod bearings in use. The most common type is the precision-insert, interchangeable bearing which requires no boring, reaming, or other fitting for its installation. These bearings are steel or brass-backed inserts lined with about .0025" of bearing material. On this type, it is not

necessary to remove the piston and connecting-rod assembly to replace rod bearings, nor does the crankshaft have to be removed completely in replacing the main bearings. Anyone with limited knowledge can install them without special tools.

The other two types are the thick-walled bearing and the direct-babbitted bearing, both of which are bored or reamed to exact size after being assembled in the crankcase or on the connecting rod. With these types, the pistons and connecting-rod assemblies must be removed to replace rod bearings, and the engine must be removed from the chassis to replace main bearings. Adjustments, however, can be made by removing shims.

It is essential that the proper clearance be maintained between the inside surface of a bearing and the outside circumference of the shaft that revolves within it. In checking clearances, remember there must be a space between the bearing face and the shaft for a film of oil to separate the surfaces in order to prevent metal-to-metal contact and resultant friction. The oil allows no more play than a shim of the hardest steel, so in leaving this space, there need be no fear of bearing knock.

Sabotaging Your Engine?

RINGS AND VALVE GUIDES HAVE BEEN REPLACED

The amount of this oil clearance should be as recommended by the manufacturer. However, when this information is not available, allow .001" for each inch of shaft diameter. For example, if the diameter of the shaft is 2", the clearance should be .002".

Rod bearings on a Ford V-8 are of the "floating" type, which means that clearance should be provided on the outside as well as on the inside of the bearing shell. The correct clearance between the shaft and bearing and between the bearing and connecting-rod bore is .0015".

Cleanliness. Before installing bearings, the interior of the engine should be cleaned thoroughly. This cleaning job should extend to the oil pan, oil lines, connecting rods, crankshaft, caps, and all other parts. The presence of one small particle of metal, carbon, or sand lodged between the back of the bearing and the rod or cap, or between the face of the bearing and the crankshaft, will cause a hot spot due to the elimination of the oil clearance at that point. Eventually this will result in a bearing failure or a scored shaft.

Fitting Bearings. Bearings of the precision-insert type should be replaced in sets, and under no circumstances should you attempt to file or alter the bearing caps to obtain proper bearing fit. If the bearing is not designed for fitting with shims, they should never be installed. Always use shims, however, in bearings designed to take them.

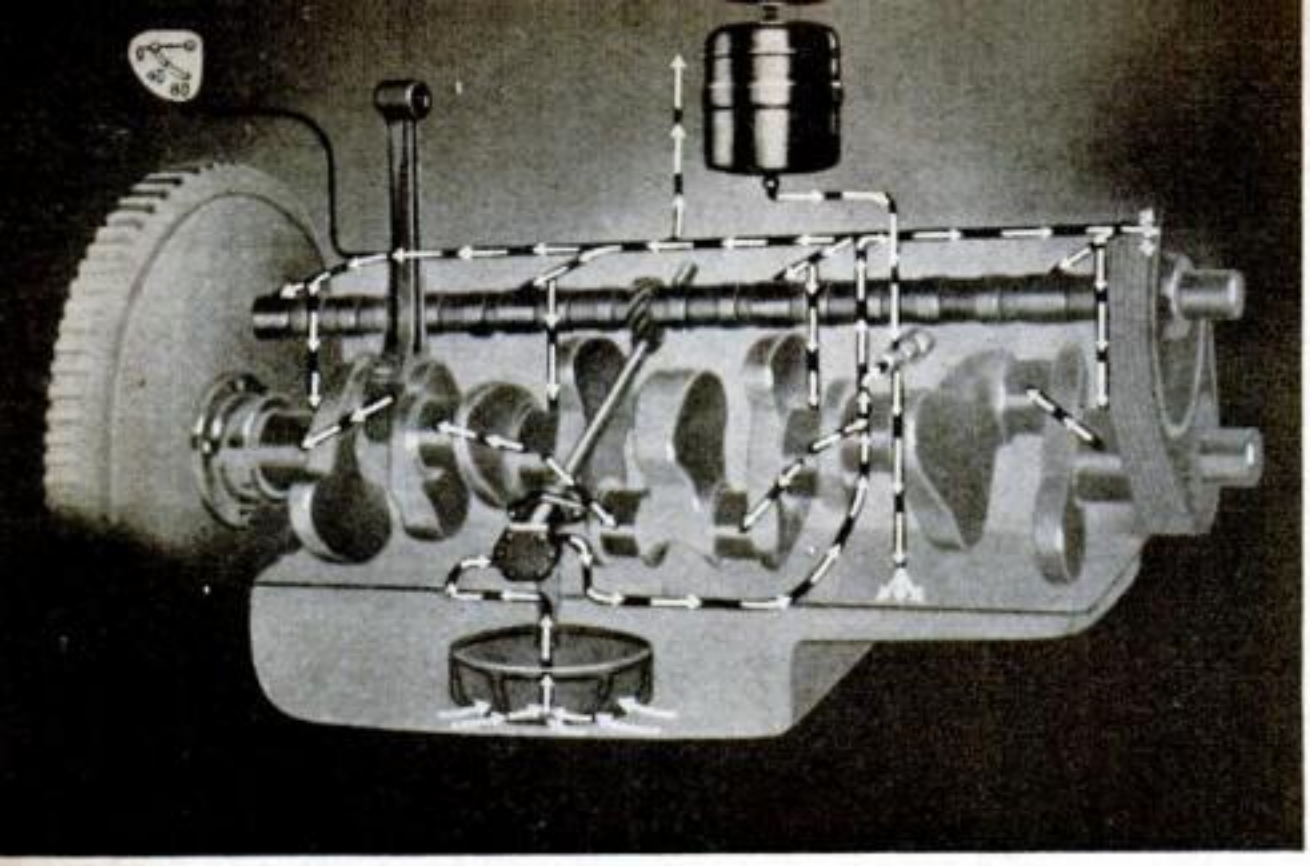
When a precision-insert bearing is worn, replacement can be made without removing the rods or crankshaft. To replace main bearings, remove the bearing cap and take out the worn lower shell. A suitable tool can be made to remove the upper shell by using a cotter pin with the rounded end flattened to form a *T*. Insert the long end of the pin in the oil-passage hole of the crankshaft and, by rotating the shaft in the reverse direction, bring the T-shaped head into contact with the bearing so as to force it out.

To install a bearing, place a new upper shell on the crankshaft journal with the locating notch in the correct position, and rotate the shaft to turn the shell into place. Then install the lower shell in the cap and replace the cap. Connecting-rod bearings of this type are replaced simply by taking off the bearing cap and slipping the old shells out and the new ones in.

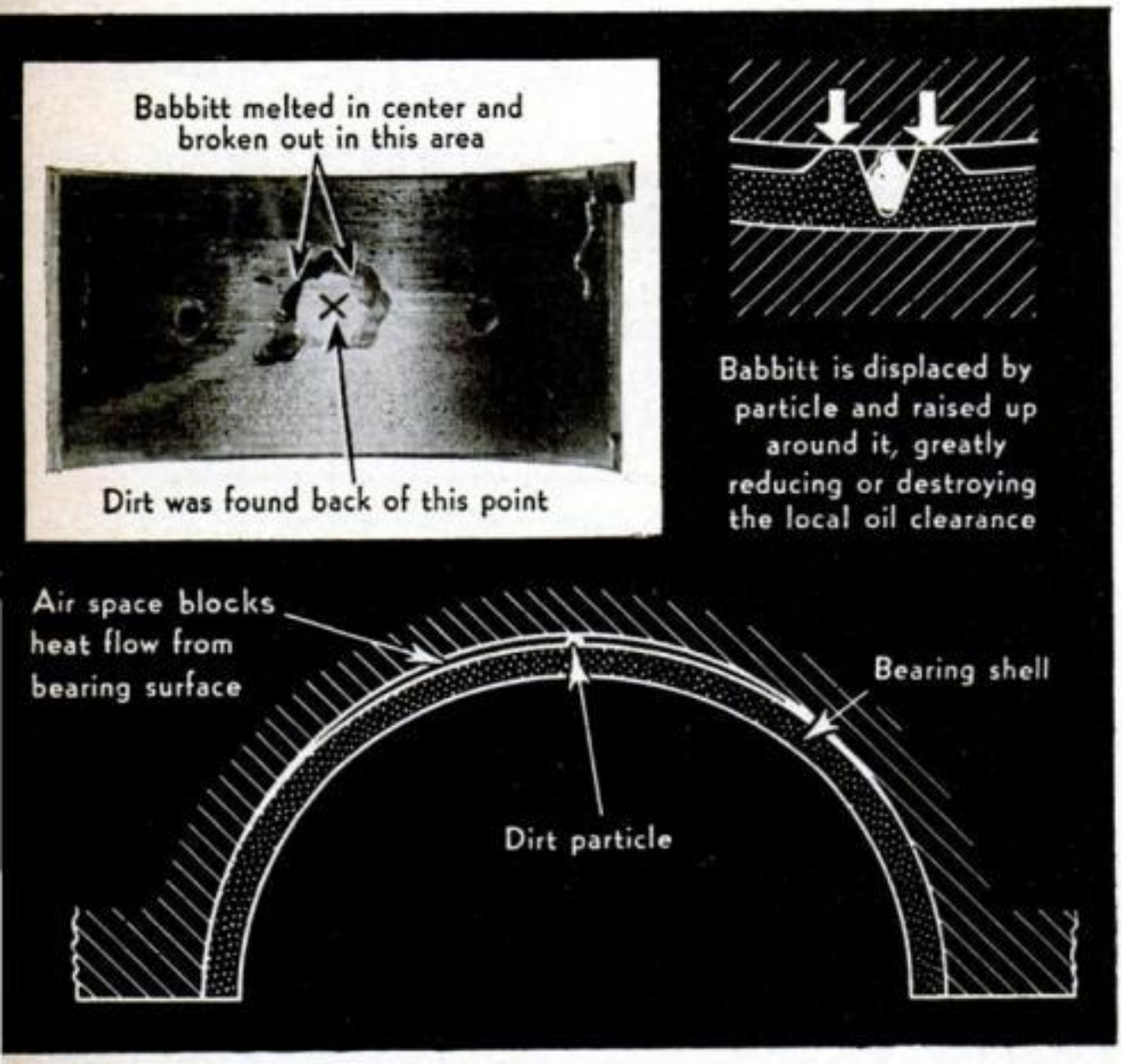
To check the fit of bearings, use a piece of brass shim stock ¼" wide and ¼" shorter in length than the bearing. The thickness should be about the same as the minimum allowable clearance. If desired, this checking shim can be made from cigarette papers, which are from .0008" to .0016" thick. Use one or more to obtain the desired thickness.

Lay the checking shim lengthwise in the center of the bearing, install the bearing cap, and tighten the cap bolts. Test the fit of a main bearing by rocking the crankshaft through an arc of 2"—not more than 1" in either direction. If the shaft is movable, but with a fairly heavy drag, the fit is good. Now remove the checking shim and replace the cap, but do not tighten the cap bolts, as this bearing must be loose in order to check the fit of the other bearings.

When connecting-rod bearings are fitted properly, it should not be possible to move



A typical lubrication system (left) pumps oil to the main bearings. The oil enters holes in the crankshaft and through small passages travels to all the connecting-rod bearings



Grit in oil scores soft bearing faces; failure to clean dirt off the seat burns out bearings by preventing normal heat dispersal

babbitted bearings, simply remove the bearing caps and remove an equal number of shims from both sides until a metal-to-metal contact is established with the crankshaft. Then replace the same thickness of shims on each side to establish the correct clearance. However, if the bearing material is rough or shows only partial contact, the bearing may be scraped to obtain maximum contact. This is a job for an expert. If the babbitt is cracked or worn excessively, new bearings should be fitted and line-reamed to fit the crankshaft.

Ford V-8 Connecting Rods. In these engines, connecting rods from two opposing pistons operate side by side on each crankpin and on one bearing assembly. These bearings are made in halves and have bearing metal applied to both the outside and inside surfaces. The rod rides on the outside circumference of the bearing and the inside face of the bearing rides on the crankpin. With this design, the bearing is free to "float" or turn independently.

Oil clearance must be provided on both sides of this type of bearing, and end play must exist between it and both rod and crank cheeks and also between rods. These bearings sometimes spread, reducing the clearance between the back of the bearing and the rod. Bring a spread bearing back to shape by holding it on a wood block and striking it gently with a soft mallet. Check carefully for binding when reinstalling such a bearing.

Reassembling. If the original bolts cannot be used for any reason, the new bolts must be an exact fit for the old holes. This is necessary to avoid spreading of the bearing, as illustrated in a drawing on page 128, which would allow too great an oil clearance space on the sides of the bearing next to the bolts. Excess oil acts as an insulator, causing overheating and damage to the bearing metal at these points. Be sure to replace all cotter pins after tightening the nuts.

the rod endwise by hand when the checking shim is in place, but a light tap with a hammer should move the rod endwise along the shaft. If, when checking a main bearing, you find that the crankshaft moves easily with the checking shim in place, or, when fitting a rod bearing, that the connecting rod can be moved by hand, that bearing is too loose. In this case, an undersize bearing of the correct diameter will be needed. To determine the proper undersize required, keep increasing the thickness of the checking shim until you discover the right fit.

Bearing Adjustment. To make an adjustment of thick-walled babbitt or direct-

AUTO Ideas

WATER IN A GAS TANK can be gauged accurately and instantly with the aid of a new chemical paste that is simply spread on the measuring stick and turns from gray to red on contact with water. The paste is not injurious to the hands and may be applied quickly with a finger when the presence of water is suspected in tanks such as those in use at airports, marine terminals, bulk plants, and service stations. Water at the bottom of the tank changes the color of the chemical, leaving a clean, sharp line at the gas-water dividing level.

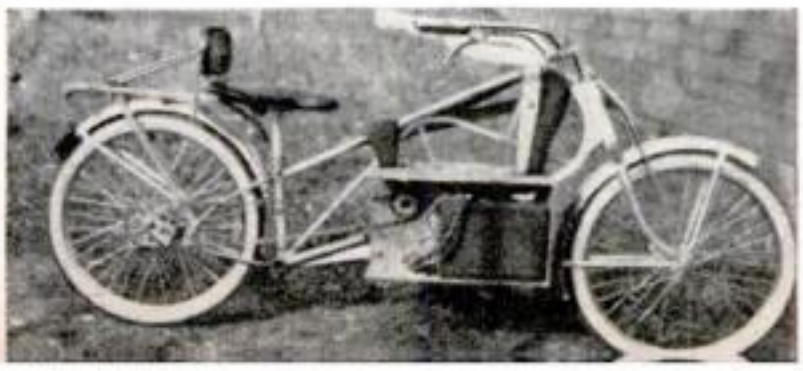
The paste is not subject to evaporation and may be kept indefinitely, a 2½-oz. jar being enough for about 500 tests. It is also not affected by gasoline, and that left untouched by water may be scraped off the gauge and returned to the jar for reuse.

LIGHT TIRES ON THIS TRAILER and wood instead of steel construction save critical materials in the transportation of war-plant and other workers. The trailer mounts eight tires of the new Victory type that use but a few ounces of crude rubber compared to the 60 percent of crude required for heavy bus tires. The trailer seats 24 persons, and the converted sedan pulling it carries 15 more.

How Ingenious Readers Solve Their Gasoline Problems

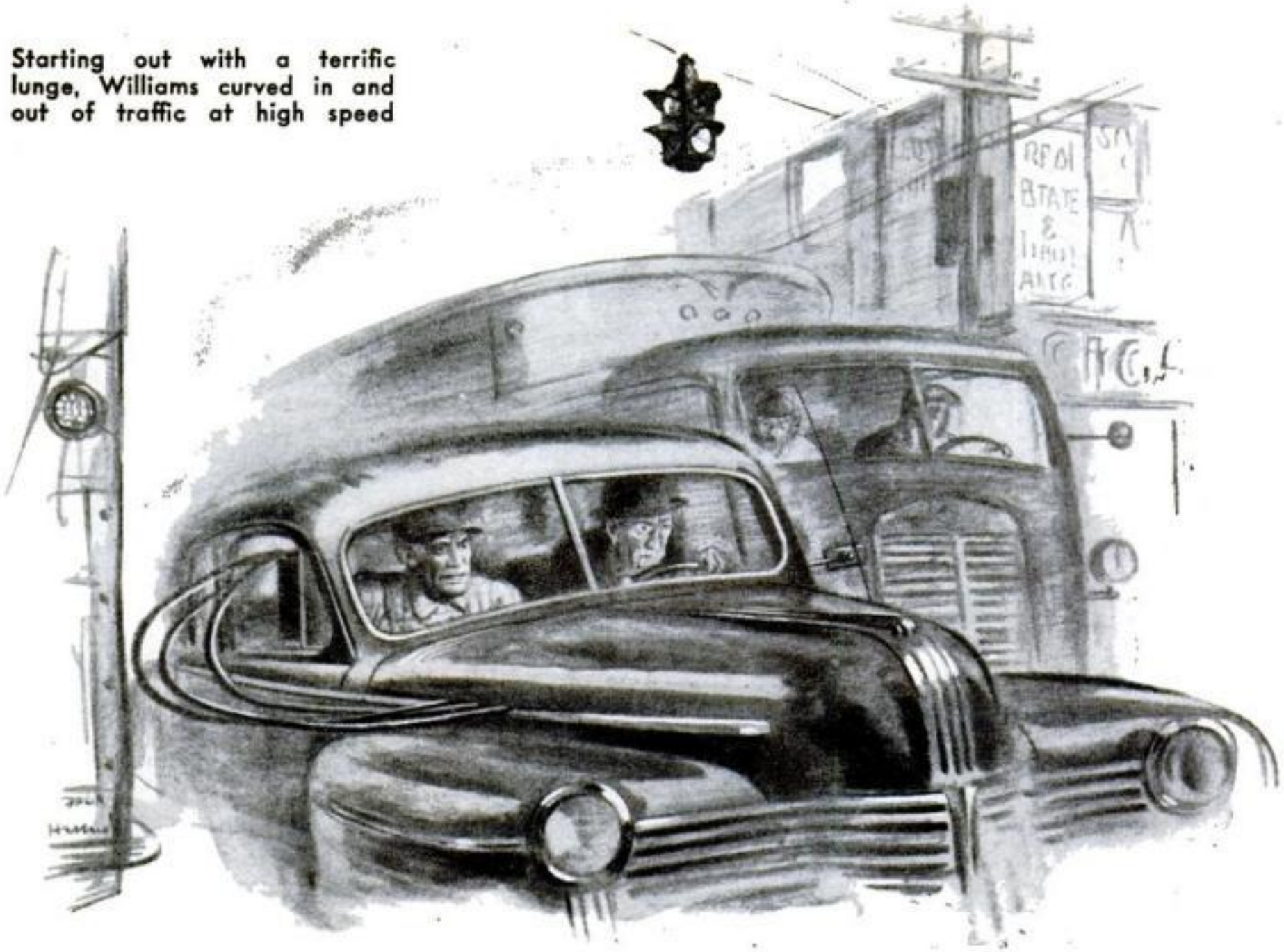
BICYCLE WHEELS mounted on a frame of thin-wall conduit and powered by a 2½-hp. motorcycle engine form the basis of this motor bike built by Edward Stuebe, of Watertown, Wis. The machine can do 35 miles per hour.

AN ELECTRIC BIKE may be made from a bicycle by installing two storage batteries to power an old 12-volt Dodge starter-generator. With a sprocket ratio of 1 to 3, Walter V. Evans, of Buffalo, N. Y., gets over 50 miles per charge.



RIDING TANDEM on a homemade motor scooter that boasts between 60 and 70 miles to the gallon of gasoline and can make 40 miles per hour does the trick for Harold G. Via, of Waynesboro, Va. Eight months of spare-time work with parts from such things as wheelbarrows, bicycles, automobiles, motorcycles, and electrical equipment brought the machine into being.

Wheels and tires were taken from two pneumatic-tired wheelbarrows. The engine is a 3-hp., four-cycle type from an old motorcycle, from which a three-speed transmission also came. Equipment includes handgrip control levers, an electric starter, head, tail, and stop lights, and an instrument panel.



Starting out with a terrific lunge, Williams curved in and out of traffic at high speed

GUS Cures a Case of Gasoline Jitters

IT WASN'T THE CAR THAT WAS HAYWIRE—IT WAS THE CUSTOMER

By Martin Bunn

HE WAS a tall man and a very thin one, and as he stood in the doorway peering into the Model Garage shop Gus Wilson noticed that he was lighting a fresh cigarette from one that wasn't more than half smoked. The hand that held the stub was shaky. "Poor guy's got the jitters about something," Gus remarked mentally. "Well, a lot of people have a right to have the jitters these days." He gave the visitor his usual friendly grin and asked, "Something I can do for you?"

The tall man's lips jerked into an answering smile as he came into the shop. "You're Gus Wilson, I take it," he said. "My name's Williams—Henry R. Williams. I'm the super at that United Machine Corporation plant a few miles down the road, and I'm living at the Park House until I can find some place to move my family. I've seen you in the dining room down there. The manager told me that you might be able to help me out."

"I'd be glad to, Mr. Williams," Gus told him heartily. "What is it you want me to help you out of?"

"I'm having gasoline trouble," Williams announced gloomily.

Gus laughed. "So's everybody," he said. "What's your particular brand of gasoline trouble?"

"Not being able to get enough of it," Williams told him. "We're working three shifts on a government contract, and I have to make two round trips per day between the Park House and the plant. The rationing board here gave me what they said would be enough coupons to see me through, but I've used all but four of them, and there are still almost two weeks to go.

"Of course, I applied for more gas yesterday, but they turned me down. Trouble is, they figure 15 miles to a gallon and—believe it or not—I can't get over 10 miles a gallon out of my car. It isn't a big bus,

either—just an ordinary '41 six-cylinder sedan. I ought to get 16 or 17 miles at least.

"Funny thing about it all is that I can't find anything wrong with the car. It runs as well as it did the day I bought it. Must be the fault of the gas they're selling these days—it's terrible!"

"Gas isn't what it used to be. There's no doubt about that," Gus agreed. "But it isn't bad enough to account for your getting only 10 miles a gallon out of a job which ought to give you 50 percent more mileage than that. Got your car outside? Good. Suppose you drive it in and let me have a look at it."

Williams ran his sedan into the shop and got out. "How's your lubrication?" Gus asked him.

"It *should* be all right," Williams said. "I had the car greased only last week, at the same time I had the oil changed."

"Good enough," Gus told him. "Then it isn't at all likely that it's friction that's wasting your fuel. But there are a lot of other things that make a bus burn more gas than it should. Maybe none of them is the matter with your car, but I'll do a little checking to make certain of that. How long is it since you had your spark plugs cleaned and adjusted?"

"Oh, maybe a month," Williams told him after a moment's thought. "No, it's a little longer than that—maybe two months. But I never miss on having that attended to every 5,000 miles."

"Two months," Gus said. "Your plugs should be all right then. But I'll have a look at them anyhow—they foul up very quickly with some of the gasoline we're getting. Bad plugs are vicious fuel wasters. Maybe you remember reading about those tests they ran out at the University of Michigan a couple of years ago—they showed that bad plugs waste one gallon of gas out of every 10 you put in your tank."

He checked the plugs carefully. Then he shook his head. "They are all giving a good, hot spark," he reported, "and that's all you can ask of any spark plugs. Well, let's see."

Working with the seeming casualness with which he camouflages his close attention to every detail, Gus checked the fuel line. He found no leaks in it. He examined the octane selector. It was set properly. Then he had a look at the carburetor jets. They were clean.

He straightened up, pulled his pipe out of his overalls pocket, filled and lighted it. Then he grinned at Williams, who was making no attempt to cover up the fact that he was rapidly losing his patience. "So far—no explanation," Gus observed calmly. "Your car seems to be in first-class condition. Of course, there may be a compression leak in one of the cylinders, but that wouldn't altogether account for such high fuel consumption. Let's get scientific and find out *exactly* what mileage you're getting. I'll hook on a mileage tester—it's one of the instruments my partner, Joe Clark, is always accusing me of liking to play with. Then, if you have the time, let's go out and take a ride."

"I'm a busy man, and I haven't any time to waste!" Williams snapped. "But I've got to get this car fixed so that it will burn less gas, so if you think you can do the job, go ahead and do it your own way. All I ask for is *results!* Meanwhile, I've got to call the plant. Where's your phone?"

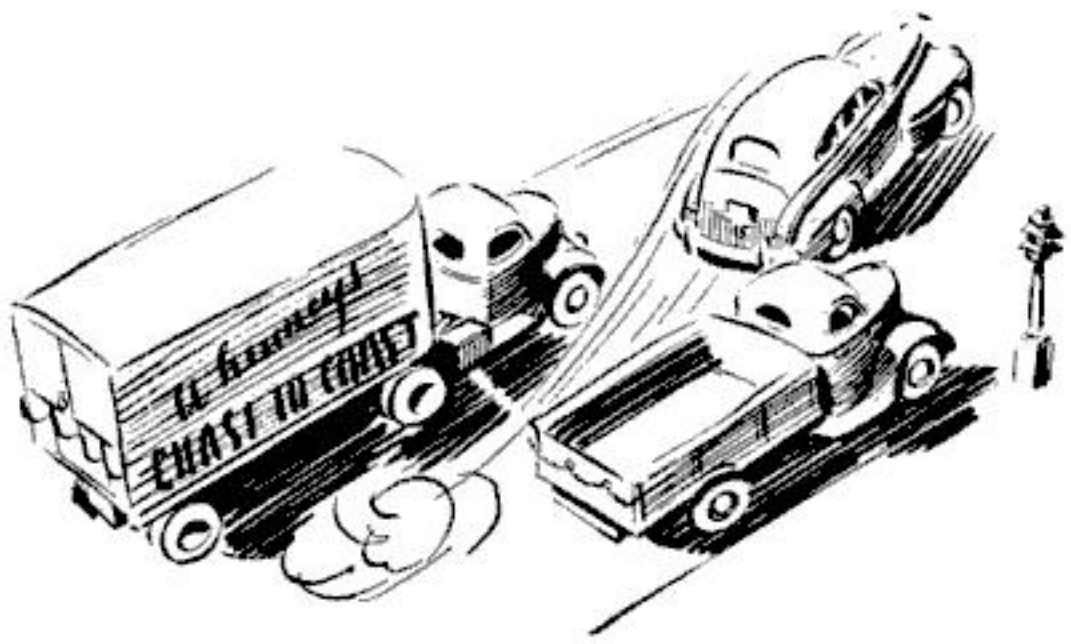
"Right in there," Gus said placidly, pointing toward the office door with the stem of his pipe.

WHEN Williams came out of the office a few minutes later, he found Gus in the driver's seat of the sedan. "Hop in, Mr. Williams," he called, "and we'll find out what this bus of yours really can do."

Williams got in, and Gus backed out of the shop and drove slowly up the road. When, about a mile out of town, they came to a straight, almost level stretch of highway, he pressed his foot slowly down on the accelerator until the speedometer registered 30 miles per hour. There was so little traffic on the road that they had it almost to themselves. Gus held the speed steadily at 30 for 10 minutes. The mileage tester showed 22 miles per gallon!

Williams lighted another of his endless chain of cigarettes and puffed nervously for a few seconds. "Twenty-two miles!" he broke out. "That's impossible, I tell you! Either that fool tester of yours is screwy, or you're crazy. Oh, I'm sorry, Mr. Wilson—my nerves are all shot. But if you can't think of any more sensible way of trying to find out what's the matter with my car than—"

(Continued)



"Let's give the tester another chance," Gus interrupted coolly. He swung the car around easily and headed back toward town. There still wasn't enough traffic to bother them, but now they were climbing a very slight grade. The tester showed a fuel-consumption rate of a gallon for 21 miles.

"That doesn't prove anything," Williams insisted. "Even if that tester is accurate—and I don't believe it is!—the conditions are altogether different. Out here we're on an almost level road with very little traffic. But between the Park House and our plant it's all up and downhill, and the traffic is heavy, and there are a lot of stop lights. You can't say that this is really a conclusive test at all, Wilson."

"I know," replied Gus, "I was thinking about that too. How's this for an idea? Supposing I meet you at the Park House after dinner this evening, and we make the round trip from there out to your plant and back just the way you make it twice a day, and *then* see what the tester shows?"

"Well," agreed Williams, a little slowly, "I just have to find out what ails this blasted car of mine. I've rather lost faith in that little tester you seem so proud of—oh well, I guess we'd better give it a fair chance. Yes, I'll meet you this evening around seven o'clock."

GUS finished eating a leisurely meal at the Park House and found Williams impatiently pacing the length of the lobby. "Thought you weren't coming after all," he grumbled, as Gus strode toward him, pipe in mouth and grinning amiably.

"Oh, I always keep appointments," laughed Gus, "but I enjoy my food, too—and I don't like to eat fast."

The two of them went out and climbed into Williams's sedan. "You drive this time," said Gus. "By the way, how long has your car been standing?"

"Two hours," the other told him.

"Then we're starting the trip with a cold engine, the same way you start most of your trips," Gus said. "That accounts for some part of your high fuel consumption—when you start a short drive with a cold engine, your fuel mixture stays rich for most of the trip. Still, that wouldn't account for the amount of gasoline your car uses.

"Well, suppose we start. We'll have to get this mystery solved sometime. I always say there's no time like the present when there's a trouble-shooting job on the fire."

Traffic along the highway was very heavy. Busses, trucks, taxis, and a few private cars filled the road. Williams started out with a terrific lunge; then, driving as fast as he could, he curved in and out of the traffic. When a red light forced him to stop, he kicked on the brakes hard, almost jerking Gus out of his seat, and when he started again he accelerated rapidly. Gus, sitting beside him, smiled inwardly but held his peace. The mileage tester now showed the rate of fuel consumption to be a gallon for 10 miles.

"Aha!" said Williams triumphantly. "Didn't I tell you! Now that tester of yours is working right!"

"Tell you what," Gus answered, "let's turn around and go back to town. This time, let me drive."

Conditions on the road were almost exactly the same as they had been on the trip out to the plant. Gus, however, kept the speed of the car at a steady 30 miles an hour. When he had to use the brakes, he applied them as gently as possible, and then accelerated very gradually to regain speed. A glance at the mileage tester showed that this time they had used gasoline at the rate of a gallon for 16 miles.

Mr. Williams tilted his hat far back on his head, lit still another cigarette, and sputtered, "But—but I don't understand it! It's the same road, the same car . . . Wilson, what's the answer?"

Gus chuckled. "Well," he said, "If you don't mind my saying so, the matter isn't with the car or the road at all. The matter is with you."

"With me!" exclaimed Williams. "What do you mean—with me?"

"Take it easy," said Gus, cheerfully. "You haven't committed a crime—exactly. You're just in too much of a hurry, that's all."

Williams's rather tense expression relaxed just a little. "Well, I'll be—" he said. "Do you mean to say that my driving causes that much difference in the gasoline consumption?"

"That's about it," replied Gus. "You see, you waste just about one third of your power and gasoline by accelerating too fast when you want to go and braking too severely when you have to slow down. It's a case of nerves, Mr. Williams—gasoline jitters, we'll call it. Use your head, take it easy, and see if you won't get 15 miles to a gallon out of your bus."

"You know, Wilson," replied Williams earnestly, "if I hadn't seen this little demonstration with my own eyes I'd never have believed it. And what's more I would have put up a pretty big argument to prove you were wrong. But this time the proof of the pudding is in the seeing, I guess. Anyway, I certainly appreciate all your trouble. And I'll certainly take your darned good advice."

"Good!" beamed Gus. "Glad I could be of service. And don't forget—those jitters of yours are pretty expensive. The less you have 'em, the more gasoline you'll have!"

Both our own and enemy disabled equipment is repaired and returned to action. Here's a half-track back from the Tunisian front

Trouble-Shooting Under Fire

ARMY MECHANICS, TRAINED FOR DOUBLE DUTY, ARE AS QUICK ON THE TRIGGER AS THEY ARE WITH A MONKEY WRENCH

THE soldiers in Uncle Sam's mobile ordnance-repair units have to be as versatile as any fighting men on the face of the earth—able to repair anything mechanical from a Swiss watch to a piece of heavy artillery, yet ready to drop tools, snatch up automatic weapons, and give battle at a moment's notice.

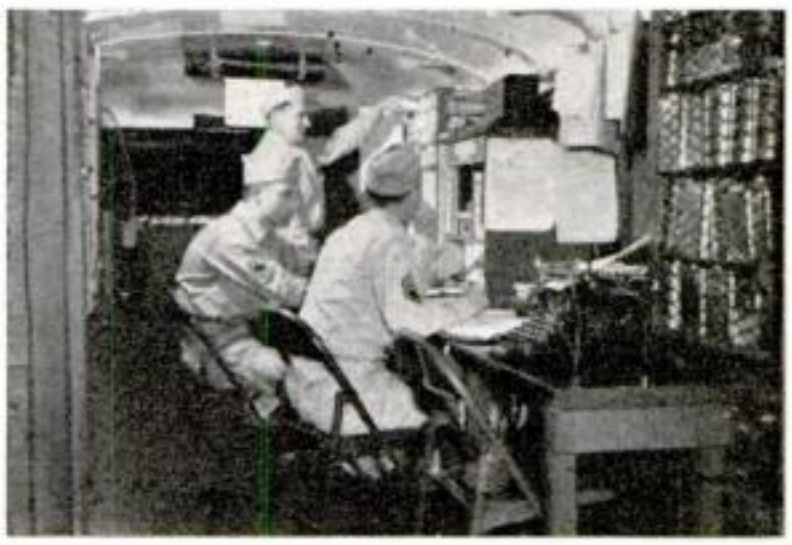
Time was when ordnance men were technicians and nothing else. Modern war changed that, with fast enemy motorized units sweeping behind the main battle lines, or swarms of parachute troops suddenly dropping out of the skies to slash at supply lines or repair bases.

A normal mobile ordnance-repair company will include about 150 men and 25 vehicles ranging from a handy utility jeep to a massive brute of a 10-ton La France wrecking car which can lift and tow any armored vehicle short of a heavy tank. The company tries to set up shop in wooded terrain, getting the best possible concealment while still leaving roadway enough for crippled vehicles to be brought in for major repairs. But the outfit doesn't just wait for business. It sends out special repair units as they are needed.

The trucks and cars of the company, tucked away in bivouac a mile or more off the main road, are miracles of compact organization, with precision tools and heavy equipment including lathes and grinders. They carry their own electric-power plants.

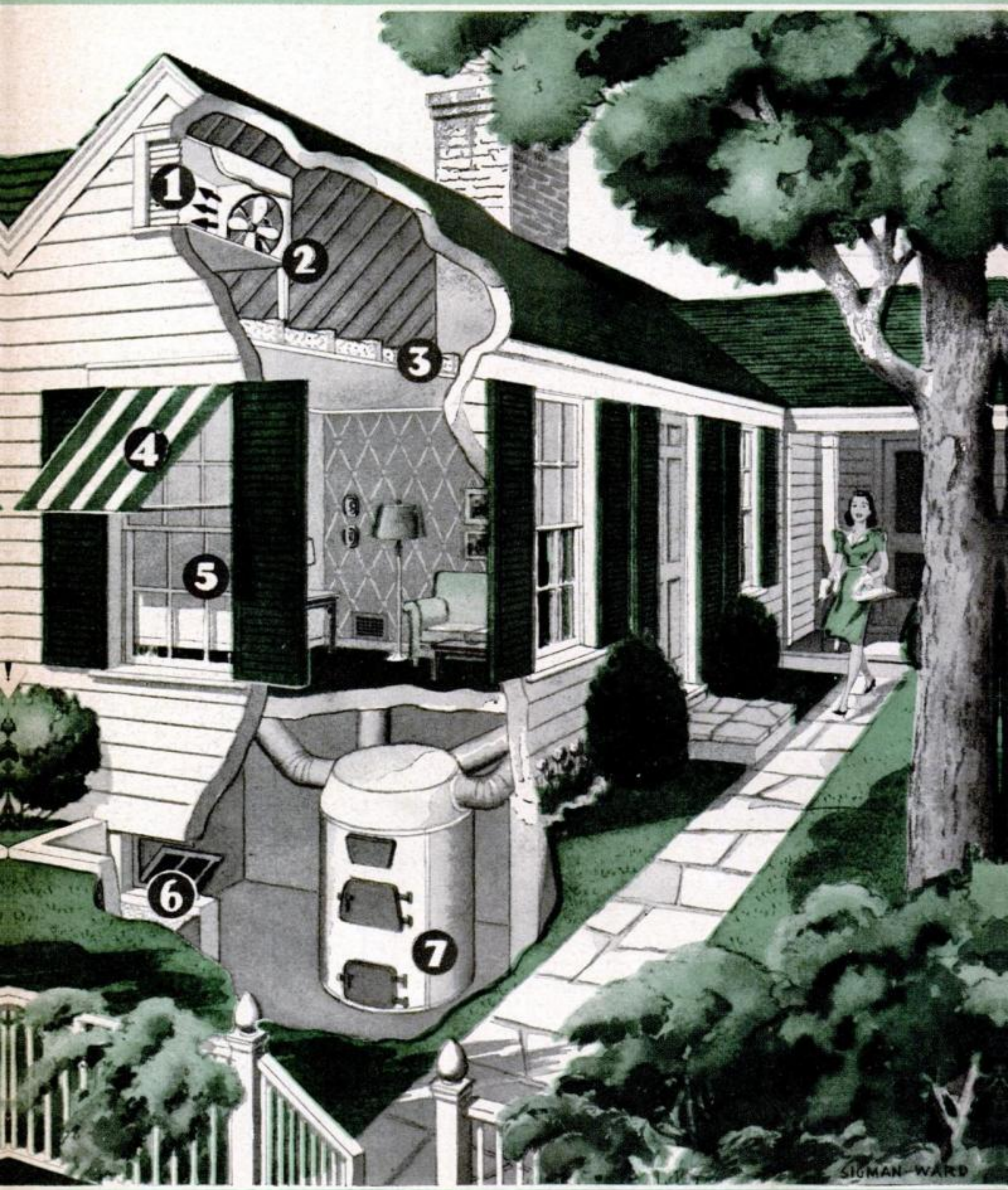
Top and sides of field shop truck are raised to give fighting repairmen more working room

Technicians repair delicate precision pieces as well as heavy tractors, tanks, and trucks



A spare-parts truck also includes a shop office (right) where paper work is done and all records are filed

HOME AND WORKSHOP



HOT AND BOTHERED? Try these remedies for home comfort. From attic to cellar they are: (1) an open window or louver to allow warm air to escape, (2) an exhaust fan to blow it out, (3) insulation, (4) awnings, (5) closed windows and double shades, (6) an open basement window, (7) a blower fan attached to the hot-air furnace

How to Keep Your Home Cool for Hot-Weather Comfort

By J. HAROLD HAWKINS
Author of *Your House*

RELAXATION comes with bodily comfort, and your bodily comfort depends upon relief from oppressive heat and humidity. Any comfortable indoor temperature in summer is relative. That is, if it is 90 deg. outdoors in the shade, 75 deg. in the house will give you that desired relief. Less than 75 deg. would be too great a variation in temperatures under normal conditions, especially when you are likely to be going outdoors several times during the day.

Cooling your house to create a 15-deg. variation between outdoor and indoor temperatures, without benefit of mechanical air-cooling gadgets such as air-conditioning systems, depends to a large extent upon ventilation. Other important factors are awnings, window shades or shutters, and insulation between the joists of the attic floor, in the order mentioned.

Ventilation divides itself into natural and artificial methods. Natural ventilation consists of opening all inside doors of the house from cellar to attic, which allows warm air to rise gradually to the attic and drift out through one or the other of two opened windows or louvers located at opposite sides or ends of the attic. As the warm air escapes from the attic, it is replaced by warm air from the rooms below, and as this air moves upward, it in turn is replaced by cooler air coming up from the basement.

Outside air must be taken into the basement, normally through a cellar window near the ground level and on the shady side of the house. Any natural movement of air in your house depends upon a ready supply of fresh, cooler air to take its place as it rises. Warm air cannot force its way outside through the attic if it has to leave a partial vacuum in order to do so, and the comparatively cool air cannot rise from the basement unless there is more incoming cool air to replace it. Nor will the cooler air rise from the basement if there is any way for other air to get into the house through windows or outside doors. The house must be shut tight on all intervening floors to create a draft from the cellar to the attic.

Direct sunshine on the outside walls of the house, and especially on windows, heats the air inside the house to a marked degree. Much of this rise in temperature can be avoided if both awnings and window shades are used to keep the direct rays of the sun off the windows. Awnings should be of the open-side variety, not the type that enclose a window on three sides, to allow currents of air to pass by rather than to collect under the hot canvas and form heating zones. On the inside, two shades with an air space between them form a surprisingly effective insulating blanket before each window.

At night, when the heat of the day has cooled down to the inside temperature of your house, windows and doors may be opened for a complete change of air. Upstairs windows left open all night, if the temperature outside is cooler, will tend to cool not only the indoor air but also walls and furnishings that have absorbed heat during the day. In the morning, however, just as soon as the sun begins its warming-up process, close the house tight, lower all awnings, and pull all the shades down on the sunny side.

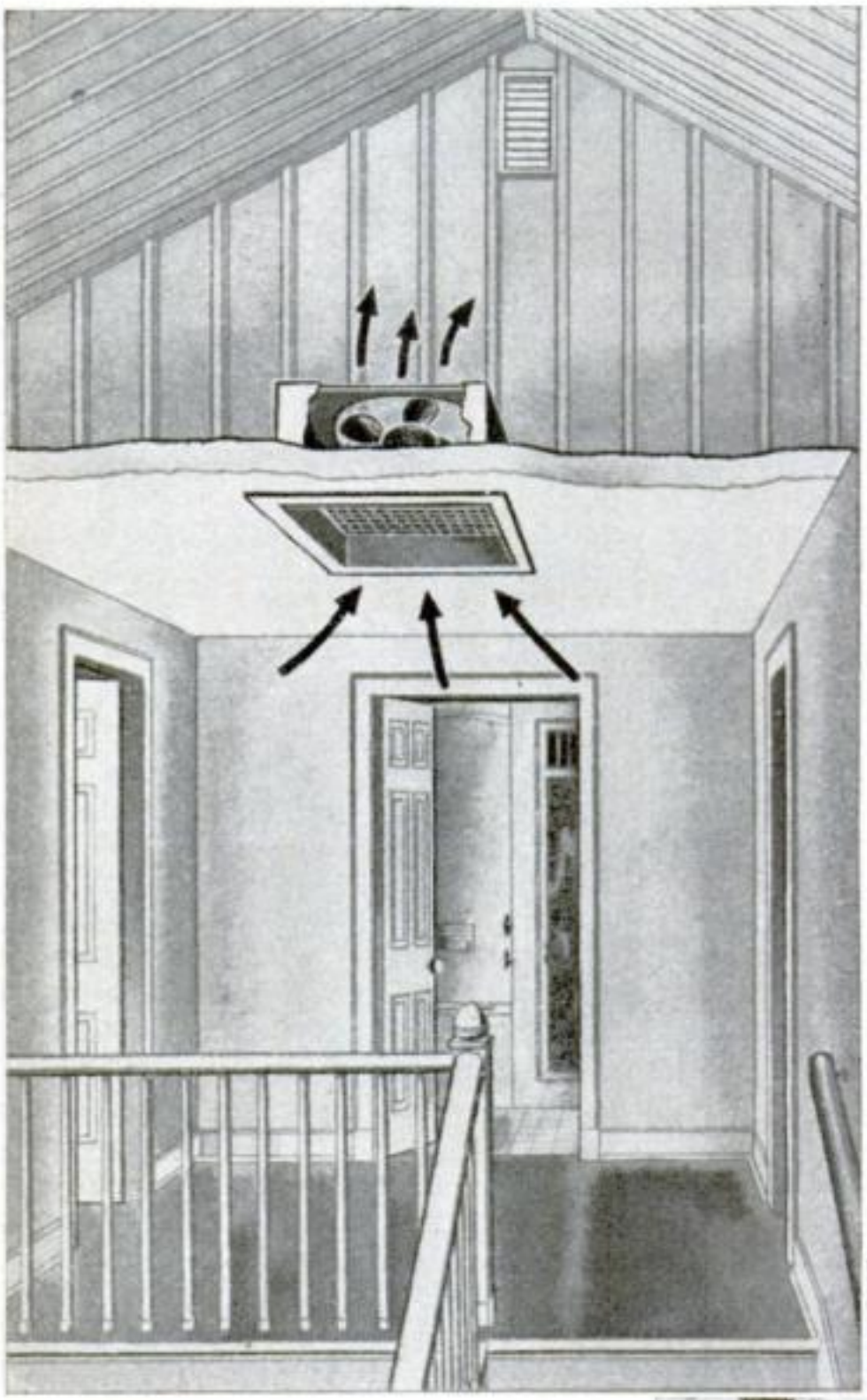
Inside doorways, as a rule, do not reach to the ceiling level by a foot or two, and even though all the doors are kept open, a thick blanket of warm air will be trapped against the ceiling and be pretty well stymied for an opportunity to move and rise to a higher level. The remedy consists of either grills or transoms between the tops of inside doorways and the ceiling, or registers through the ceilings to rooms above or to the attic. These aids for air to circulate of its own free will are very important, not only for summer cooling but for warm-air heating in winter as well. Shutter doors can be used in place of solid doors for any rooms where daytime privacy is required.

Artificial methods of air circulation give more rapid results and, of course, will do a thorough job of ventilation against odds. There are two general ways of forcing air through a house. One is to use a fan in the

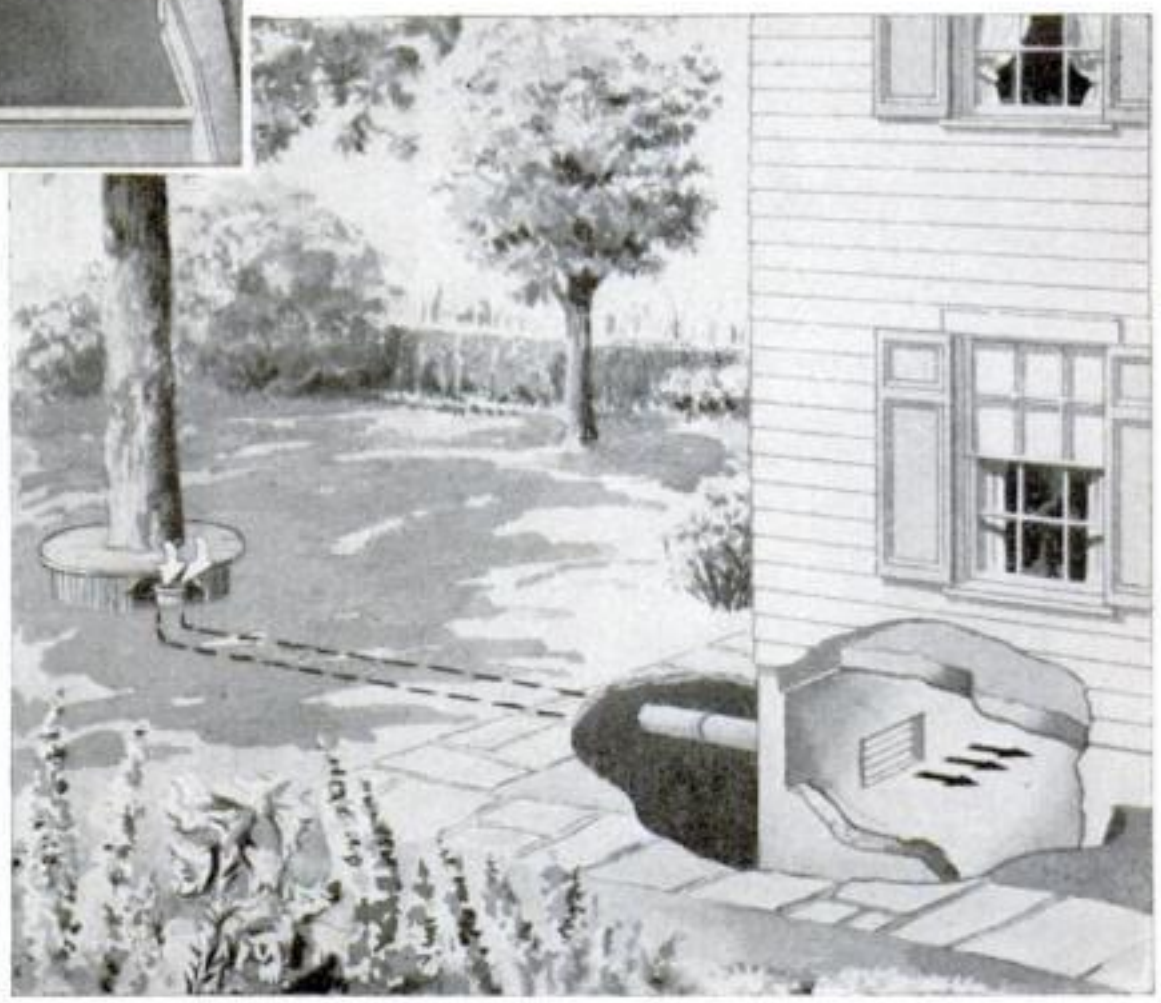
warm-air furnace to force cool air up through the regular heating ducts to the various rooms in the house. Such a circulating fan is regular equipment on many modern warm-air furnaces and can be installed in the top of the jacket of many types of old furnaces. The other means of air circulation is an attic fan which draws warm air out of the attic and delivers it outdoors through a louver, preferably one located as near the ridge of the roof as possible. Either or both fans can be operated at the same time to boost the volume of air being moved up through the house and out through the attic.

To furnish a supply of comparatively cool air for the furnace fan to handle, an intake can be built, with a little effort, by digging a trench from a shady spot in the yard to the basement. Lay a continuous line of sewer pipe in the trench and seal the joints with cement mortar to keep water from leaking into the line. This air, taken from ground level and passing underground to the basement, will be still further cooled because of its travel. It will provide a positive feed that will relieve any tendency toward forming a vacuum in the basement because of the action of the fan in taking the air out.

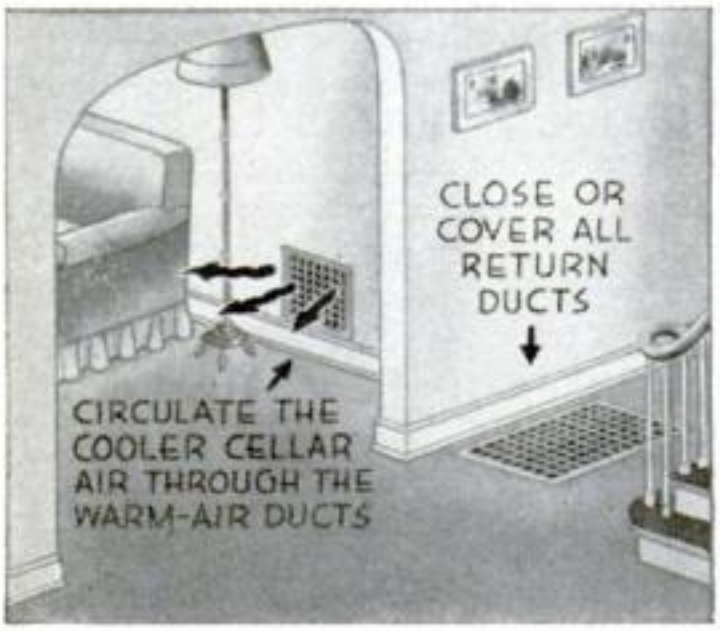
Cool air forced up through furnace ducts will tend to create a pressure in upstairs rooms which, in turn, will help force warm air up to the attic. The regular cold-air returns to the furnace from upstairs must definitely be cut off or the grills covered with rugs. Remember that the use of a furnace for cooling is the reverse of



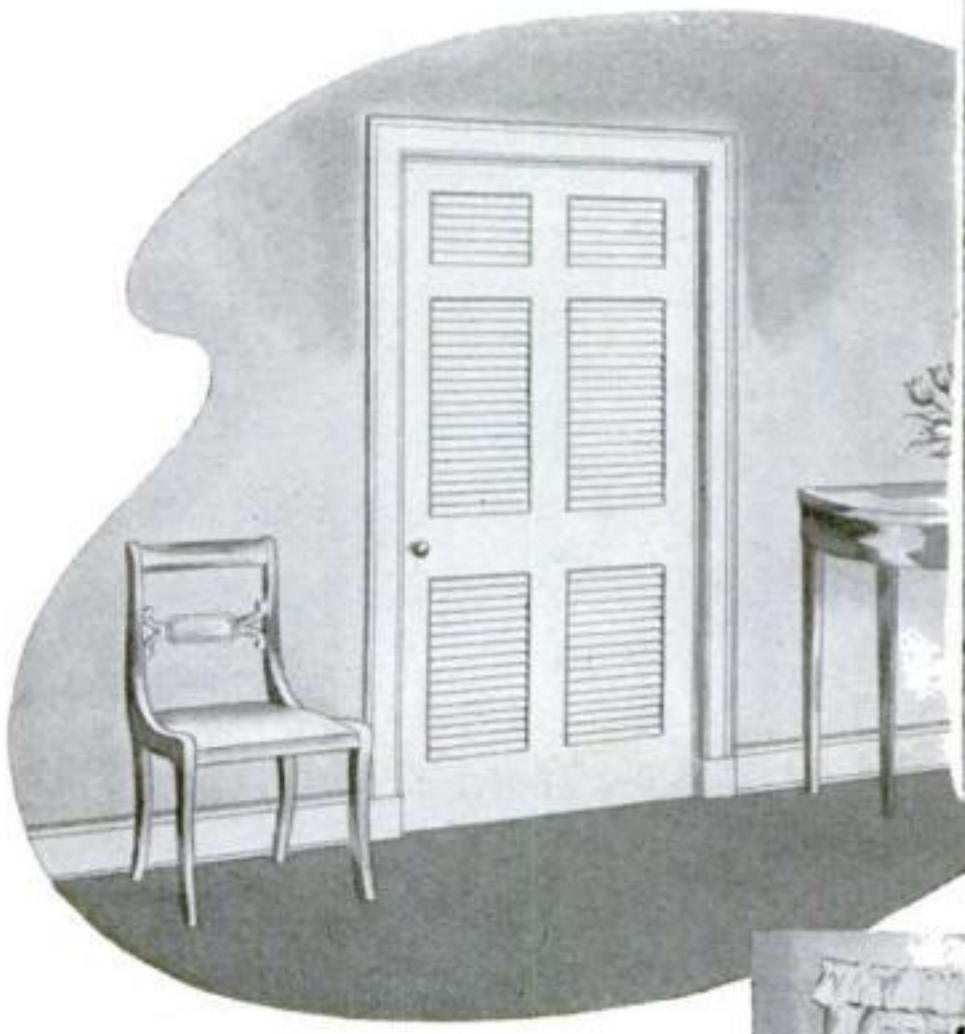
One method of getting cool, fresh air into a basement is through an underground pipe with an intake at a shady spot in the yard. This helps to replace air drawn from the basement to circulate through a hot-air system

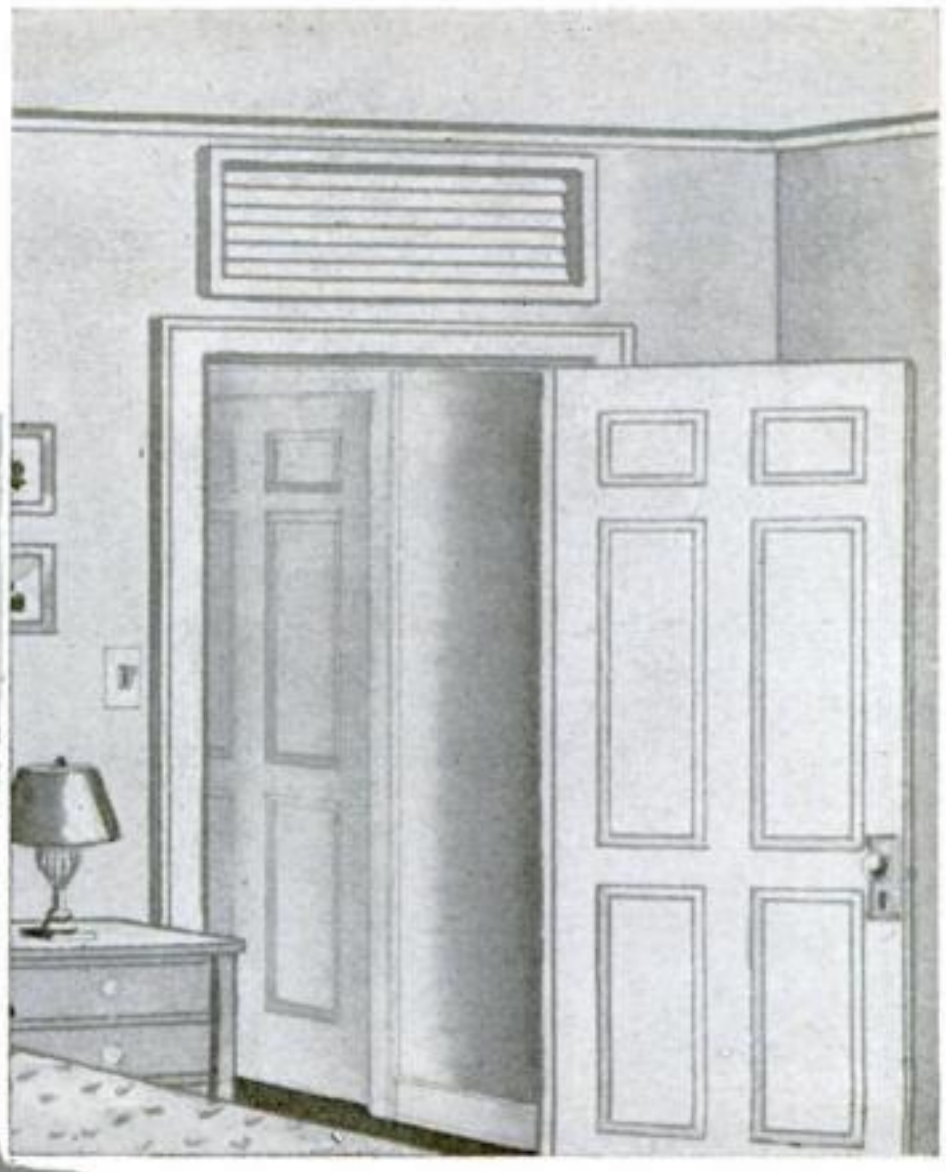


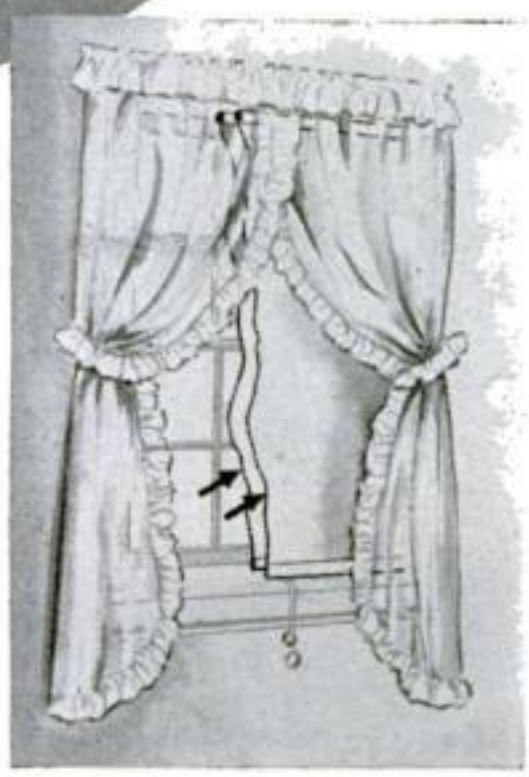
An exhaust fan over a grille set in the attic floor draws warm air up. Return ducts in a hot-air furnace system must be closed to keep cool air in the house



Open doors in all rooms inside your home allow cool air to circulate freely. If they do not reach to the ceiling, a vent or transom will keep a stagnant blanket from forming. Shutter doors may be used where privacy is desired. Two shades on the inside of a closed window will afford additional insulation against outdoor heat







using it for heating, and to draw the cool air off the floors down to the basement through return ducts would only defeat the whole cooling effort.

An attic exhaust fan, used with or without a furnace fan, is a most important part of artificial ventilation for home cooling. Such a fan, used in an attic that has no opening other than the one between it and downstairs, has a positive effect in that it constantly draws air up into the attic to replace that which it exhausts outdoors. If the exhaust fan has an intake box, it will function to better advantage than if it is merely mounted on a shelf in front of a louver. An ordinary electric fan will be of some help, but it will not be nearly as efficient as one designed for the job.

Insulation, we all know, is a barrier against heat as well as cold, so insulation in the walls of a house, between the joists of the attic floor, or between roof rafters adds its effect in the matter of house cooling. If, for instance, you have attic-floor insulation in your house, it will be a help in ventilating for coolness. Although the air under the roof will be heated as usual, the temperature of the air downstairs will be lessened because of the layer of insulation between it and the hot attic. The forced circulation of air from downstairs to the attic and out through a louver will not only further cool the downstairs rooms, but will keep up the continuous flow of new air that counts so much in summer cooling. This continuously moving air will prevent the forming of a hot-air blanket in the attic and avert a partial reduction of the efficiency of the insulation.

Humidity coupled with high temperature is particularly exasperating when you are trying to relax in hot weather. Circulating cool air not only reduces the relative humidity—because the cooler the air the less its ability to hold moisture—but moving air also assists your body in its normal function of dissipating its own heat which, summer or winter, remains at 98.6 degrees. It is surprising what a difference a positive flow of air will make. Of course an electric fan will give temporary relief, but when you shut the fan off the reaction is that of being more uncomfortable than before.

Dear Workshop Editor:

I am interested in building a simple air-conditioning unit for my home. Could you publish plans for one that would not be too difficult or too expensive to make?

J. A. – Flushing, N. Y.

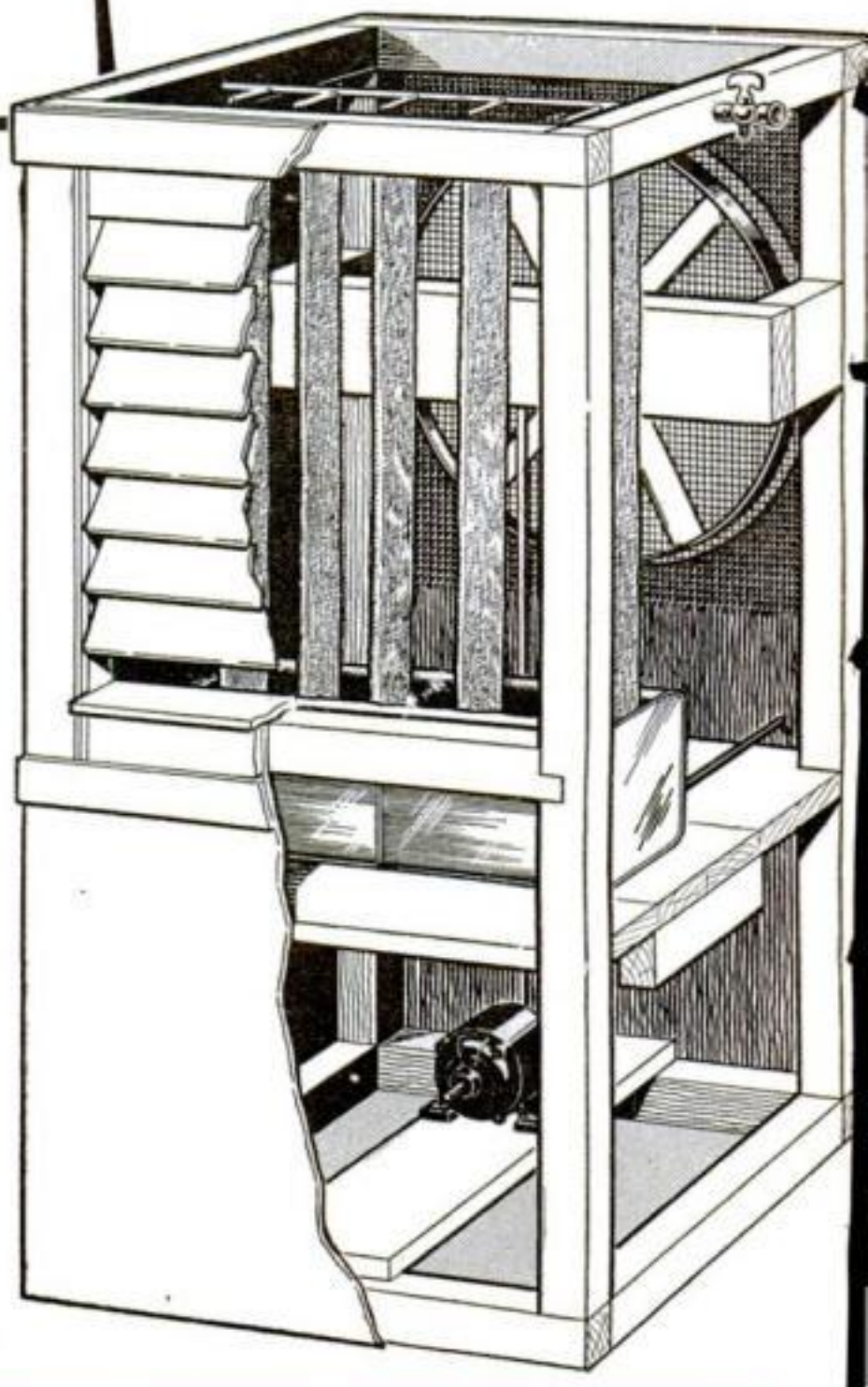
WILLIAM J. BURTON answers this query with a description of such a cooler. It consists of an old 20" automobile fan, a 1/10-hp. motor, six homemade air filters, a drip pan, and a water supply system, all enclosed in a wooden cabinet 2′ by 2′ by 4′.

Warm, humid air is drawn into the cabinet by the fan and forced past the filters, which are kept moist by cold water dripping on them from a pipe above. They not only absorb moisture from the warm, humid air, but cool the air as it passes. The water collects in a drip pan, and any excess is drained off through a ¼" copper tube located 2" above the bottom.

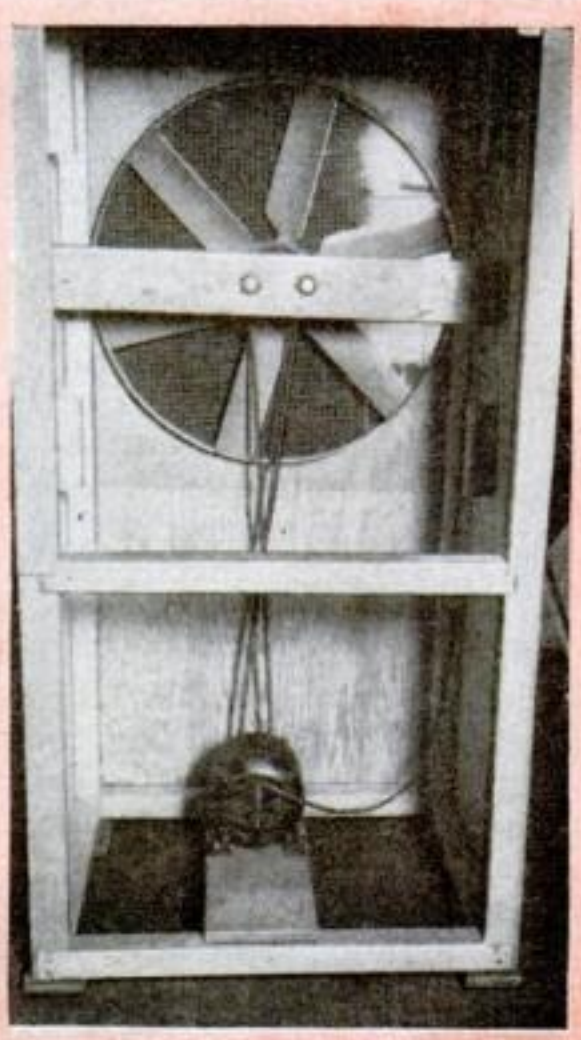
Wire screening protects the fingers from contact with the fan, while several coats of hot, boiled linseed oil seal the plywood interior against the moisture in the air. Where running water is not available, the cabinet should be built higher so that a tank may be placed in the upper part.

The 2" by 28" filters are suspended from the top of the cabinet at an angle so as to partially obstruct the passage of air. A baffle between the pan and the front of the cabinet guides the moving air to the louvered opening. Water is fed to the filters by ⅛" copper tubes soldered into a ¼" manifold. A valve of the type found on gas heaters passes just enough water to maintain a continuous, slow drip from the filters into the pan.

A hose connected to an overhead manifold supplies water to the filters. Where running water is not available, a tank may be used



Filters (left) are made of burlap sewed on galvanized-wire frames. Solder together two oil cans as shown below for the drip pan, and paint them inside with asphaltum. Mount the fan bearing on a crosspiece as in the photo at right, which shows the cabinet before the filters are set in. Fan and motor pulleys are same size



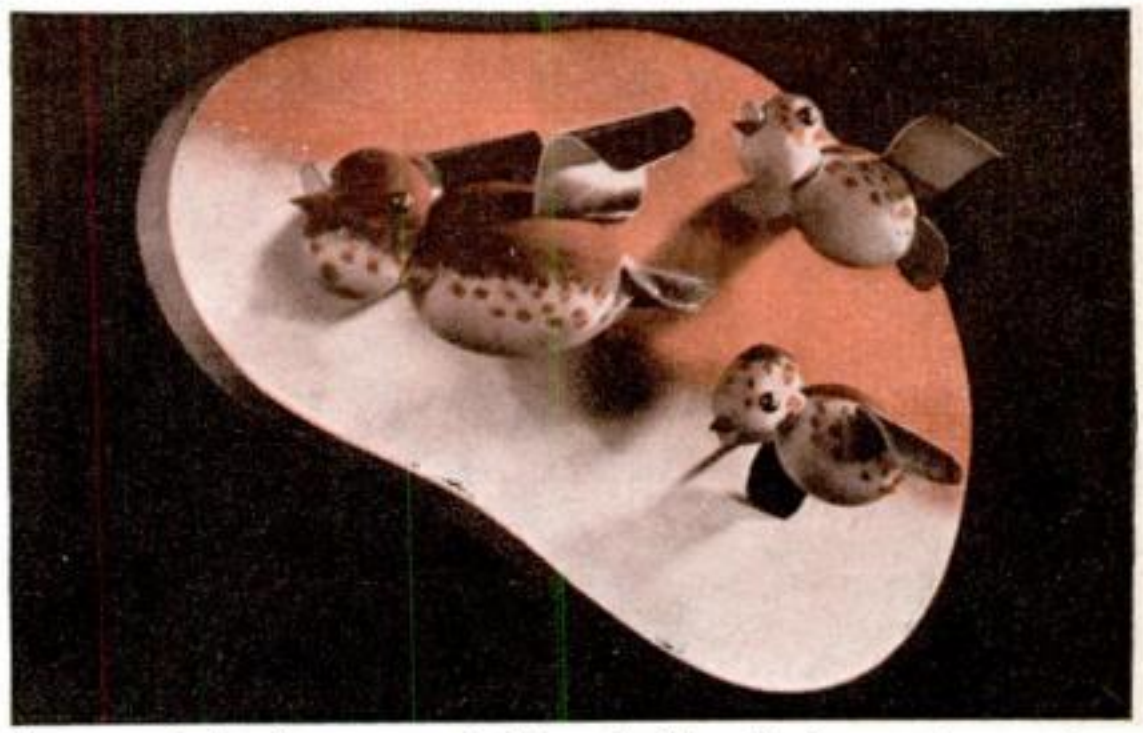
Toy Birds Enliven This Nursery Plaque

QUAINT, pink-spotted birds in flight across a rose-tinted cloud form this decorative plaque, which will intrigue children and provoke a chuckle or two from grownups.

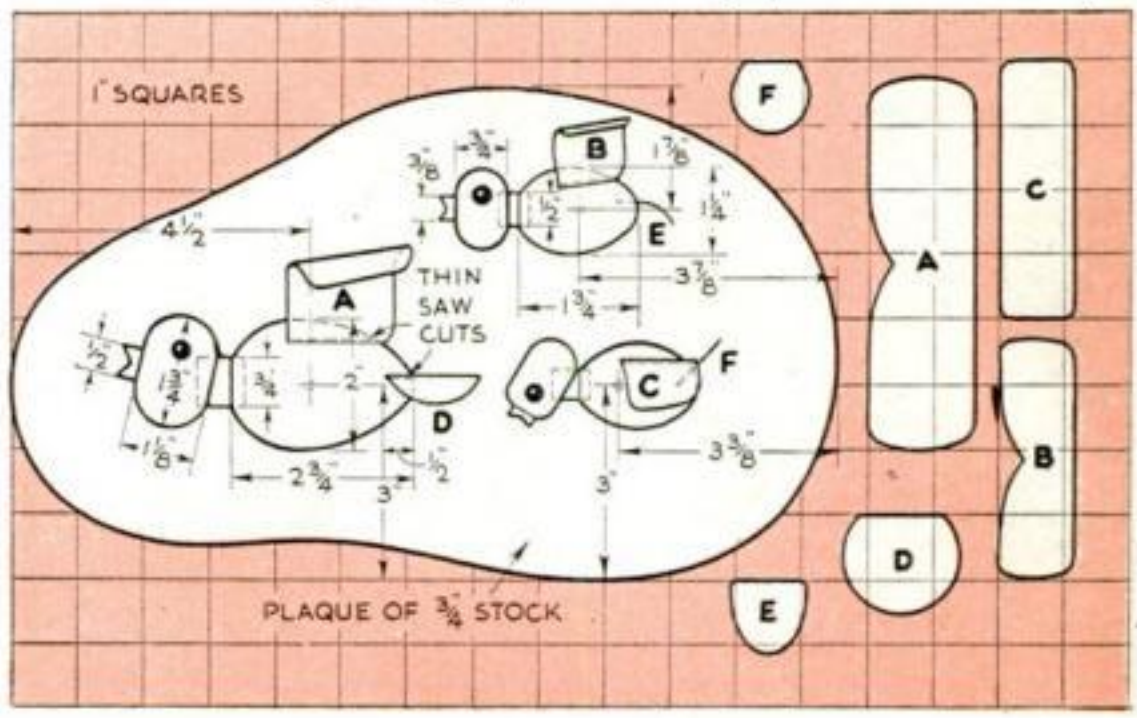
The bodies and heads of the birds are small turnings fastened together with short lengths of dowel. Round-headed brass tacks serve for eyes. Short bits of dowel are notched at one end to form the bills. Wings and tails are of bright tin cut from a tin can. The birds are mounted about 1⅛" in front of the plaque by ⅛" dowels glued into holes drilled ⅜" deep.

Both the wings and the tails fit into saw cuts. The V-cuts in wings *A* and *B* face toward the tail. All wings and tails should be fitted into the slots before they are bent.

The birds shown have pink backs, spots, and bills, and white bodies. Two tones or two colors may be applied to the plaque—for example, the top half may be pink and the lower part white. Leave the parts made of tin plate unpainted.—JUAN OLIVER.



A gay note for the nursery is this colorful wall plaque. Any number of similar birds might be grouped on a large panel in various ways

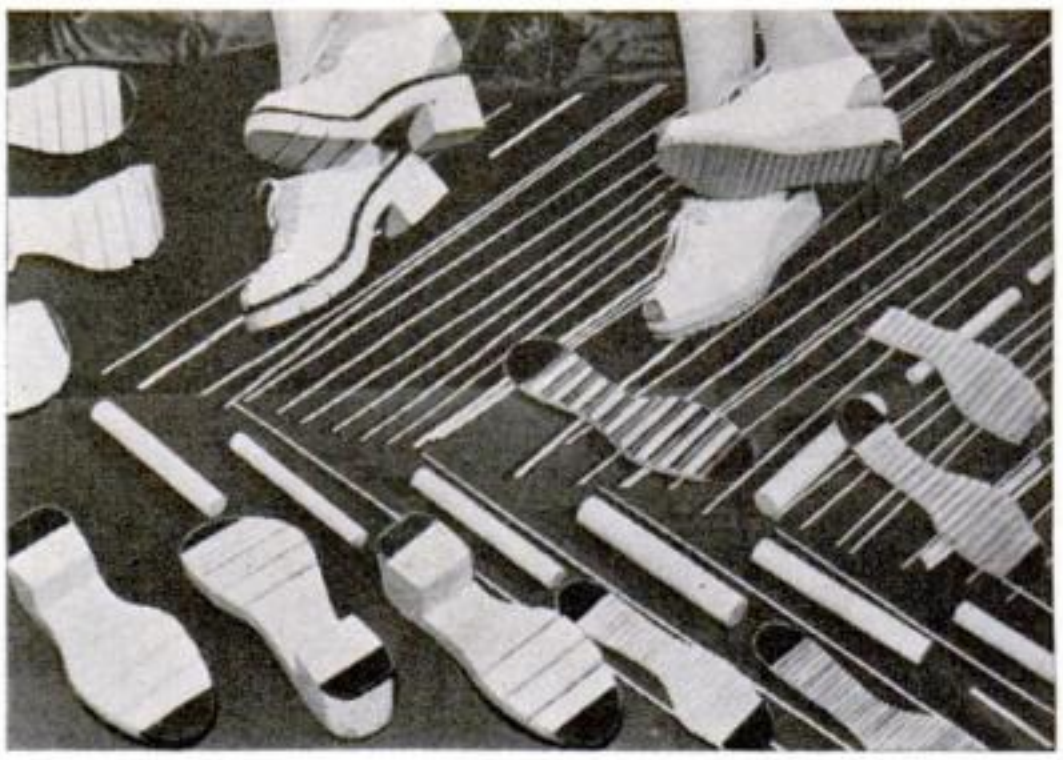


AUGUST CHECK LIST [*SHIPSHAPE HOME*]

1. Replace frayed sash cords and tighten rattling windows.
2. Make permanent roof repairs, or completely reroof if necessary.
3. Check gutters and leaders; make any necessary repairs or replacements.
4. Inspect all flashings; apply roofing compound.
5. Repair rotted porch columns, railings, and steps.
6. Waterproof basement walls during dry weather.
7. Replace or repair deteriorated siding or siding shingles.
8. Paint flat porch roofs, patching first if necessary.
9. Clean chimney flues from top to bottom.
10. Overhaul fireplace damper and clean out smoke shelf.

POPULAR SCIENCE MONTHLY SHOP DATA

GARMENT-BAG CLOSERS made out of wood, like that shown below, take the place of zippers and other types of metal fasteners now scarce. The chief parts of the closure are two well-rounded edges on the cloth and a grooved rod to slide over them. The bag is open 30" from the top to permit access, and is sealed from dust and moths when the rod is moved into place. When it is necessary to launder the bag, it is an easy matter to remove the sliding member entirely



WOODEN SHOE SOLES that have the flexibility of leather and rubber, and are said to outwear both, are now available through development of a new binding material that joins the sole with the upper. The soles are made in sections or of wooden dowels. They are bonded to a waterproof fabric made of cotton on carpet looms and impregnated with a plastic. It is "vulcanized" to the sole and then to the upper

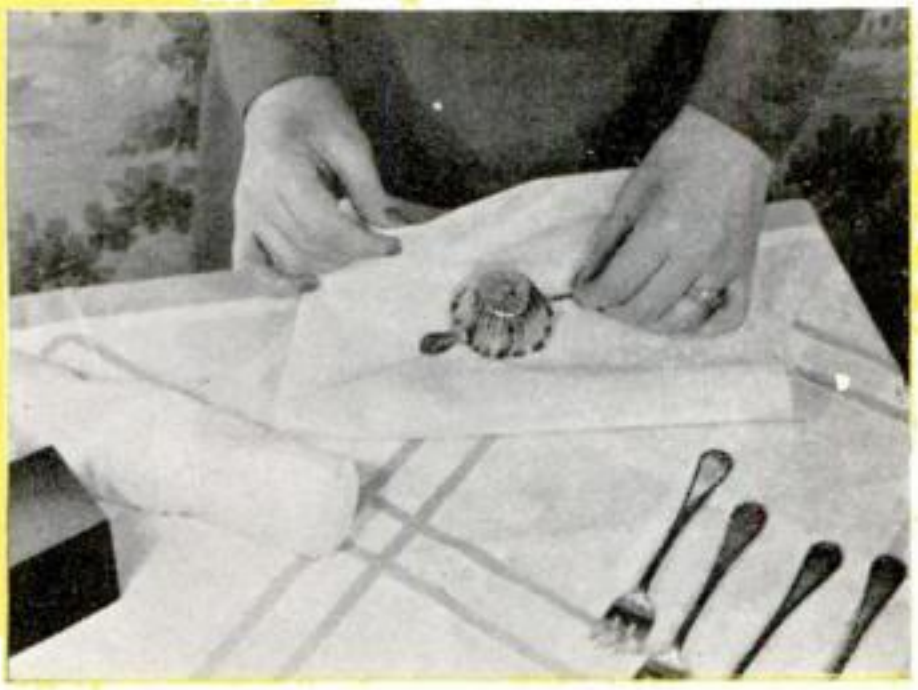
THIS PLASTIC TIE RACK with pegs for twenty ties is made entirely of noncritical materials. A hook at one end holds two leather belts, and a shallow plastic cup at the other keeps cuff links and tie clasps from rolling under the bed. Hung inside a closet door, the rack can be swung back so that it is flush with the door when not in use

AN ODORLESS DEODORANT (not shown) has been placed on the market that does away with odors by chemical action, which neutralizes them at the source instead of covering them up with another odor. It comes as a powder that is applied to the offending area either by sprinkling it from the package or by using a spray gun. Because it is non-poisonous, it can be used to kill odors in animal cages and in barns without danger to the animals. The powder can easily be removed after it serves its purpose, either by sweeping or by washing it away

SHOE POLISH and dauber are kept together in this glass container. A large compartment at one end holds the shoe-cleaning paste, while at the other end there is a smaller compartment for keeping a special applicator. Each end has its own cover. The applicator is made to take the place of a brush for the purpose of rubbing the polish on the shoe, and it is said that it will last as long as the supply of paste will, or for about six months of average use by one person. The shoe polish is available in all of the popular shades, including black, light tan, and dark tan. The compactness of the outfit makes it especially handy for those who travel

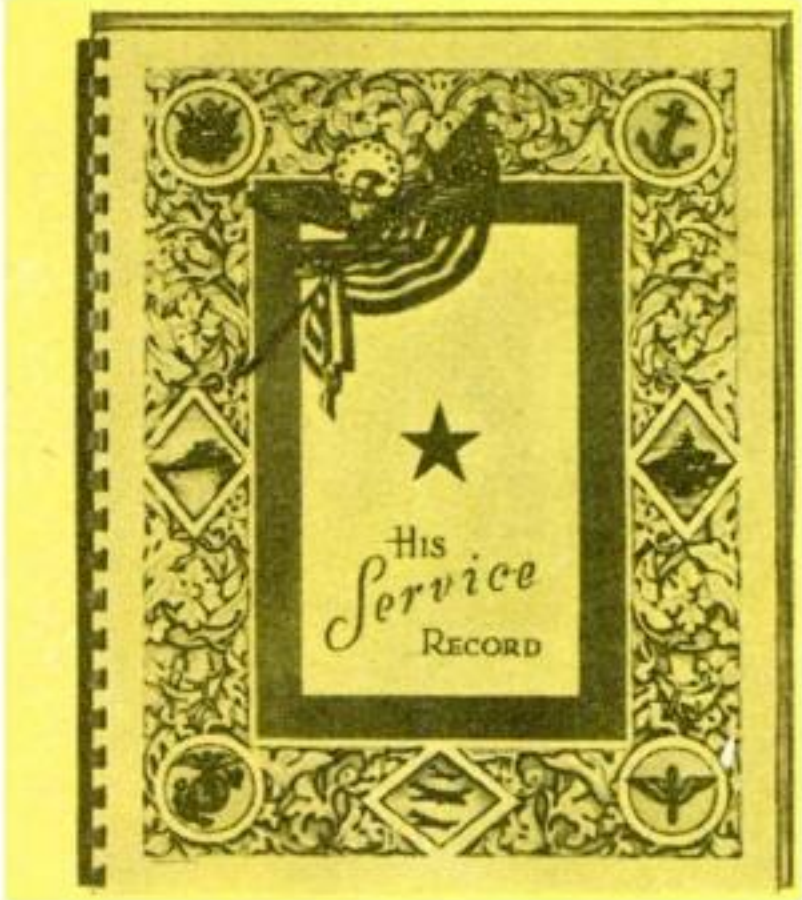
AIDS TO WARTIME

Housekeeping



TARNISHPROOFING SILVER for vacation storage is now a simple matter with a new chemically treated tissue paper. Family heirlooms, jewelry, or table service will be protected against the sulphurous fumes in the atmosphere just as long as they are snugly wrapped in the paper, which is made in various sizes to accommodate most needs

AN ELECTRIC BRUSH, shown above, picks up animal hairs and lint as it removes dust from clothing, rugs, felt hats, furniture, draperies, and the like. Static electricity generated when the brush is used causes it to attract all such loose particles. The brush handle is made of a plastic and is of a size that can be conveniently gripped for use



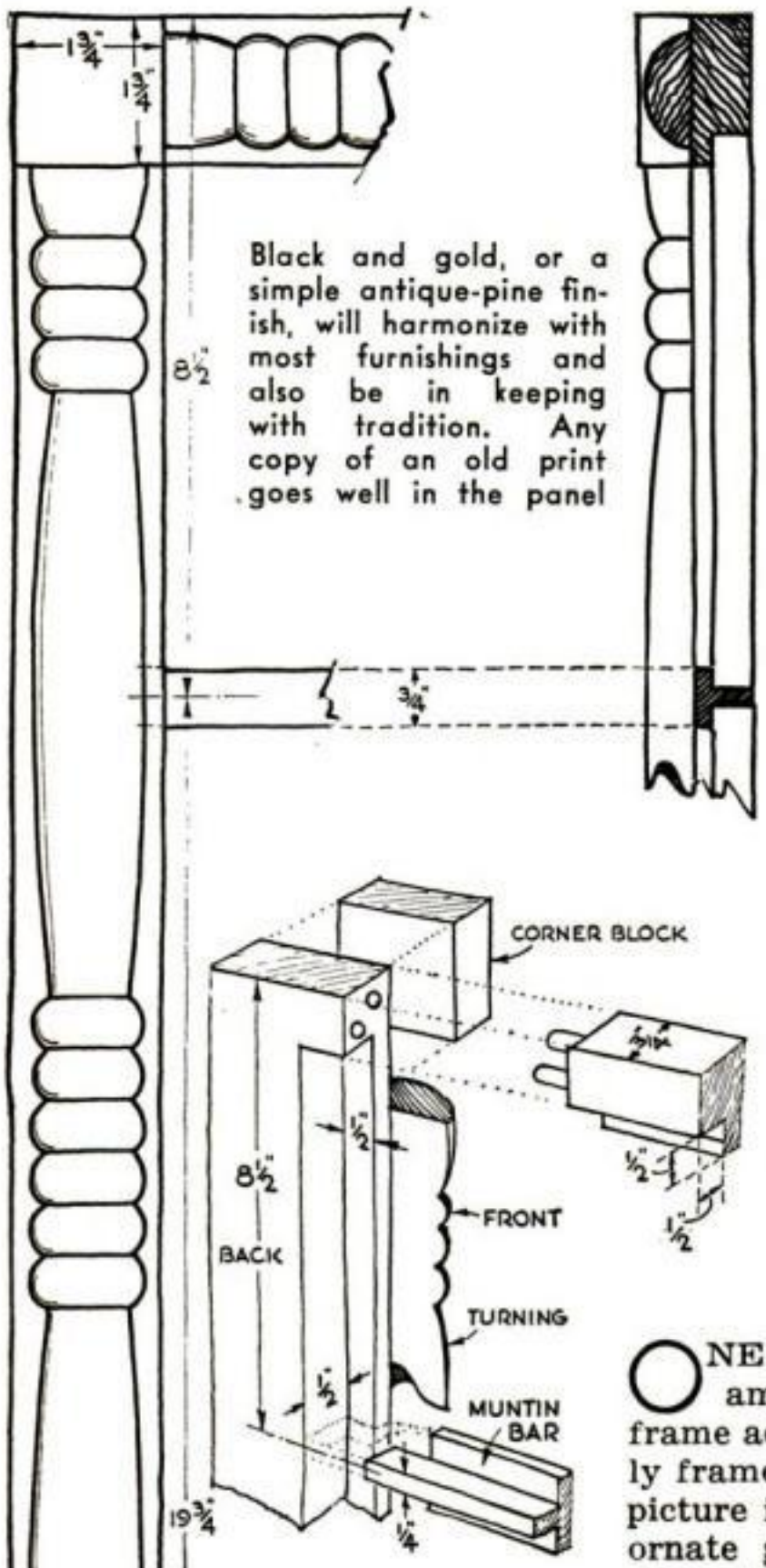
LETTERS AND PHOTOGRAPHS that a man in the service sends home can be safely treasured in this handsome record book. The leatherette-finished cover is die engraved with a full-color reproduction of the service flag. Plastic rings used as binding permit the book to be opened perfectly flat without bending the pages. Large enough to hold many letters, photos, clippings and the like, it should prove a welcome gift to any service man's family

HERE IS A CUP AND SAUCER that is really "in the groove." A groove in the saucer locks the cup firmly so that it will not tip over. These pieces are made of crackproof plastic and weigh three quarters as much as crockery cup sets. They were designed for the Navy for use on patrol bombers and similar small vessels

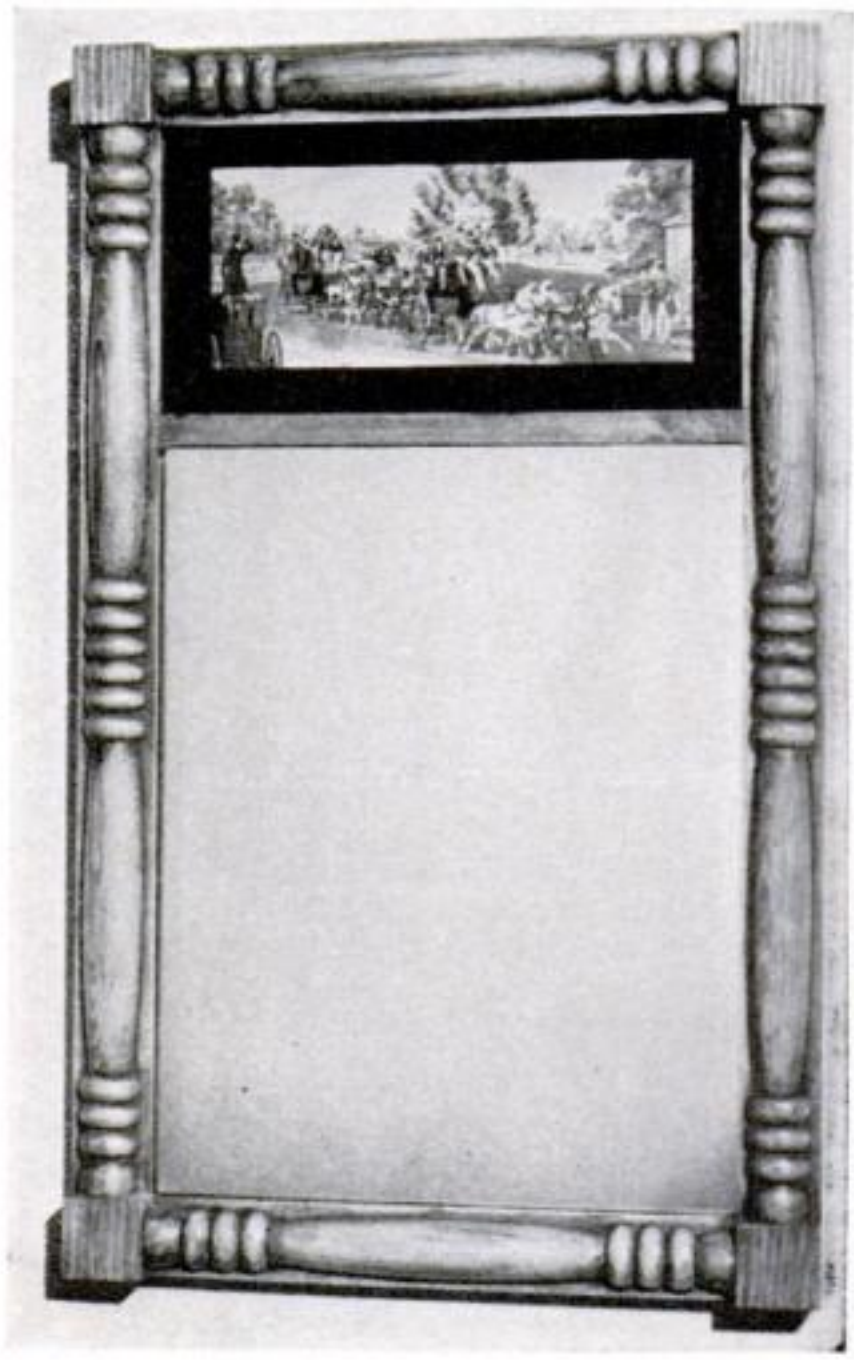
EXACTLY TWO CUPS is what this economical little drip coffee pot holds. It was especially designed for these days of coffee rationing when every single drop counts. With this pot it is easy to make fresh cups of coffee for members of families who eat their breakfast at different hours, and at the same time waste is prevented. Because it is glass, it is easily kept immaculate

Mirror of American Colonial Design

IS FRAMED WITH HALF TURNINGS



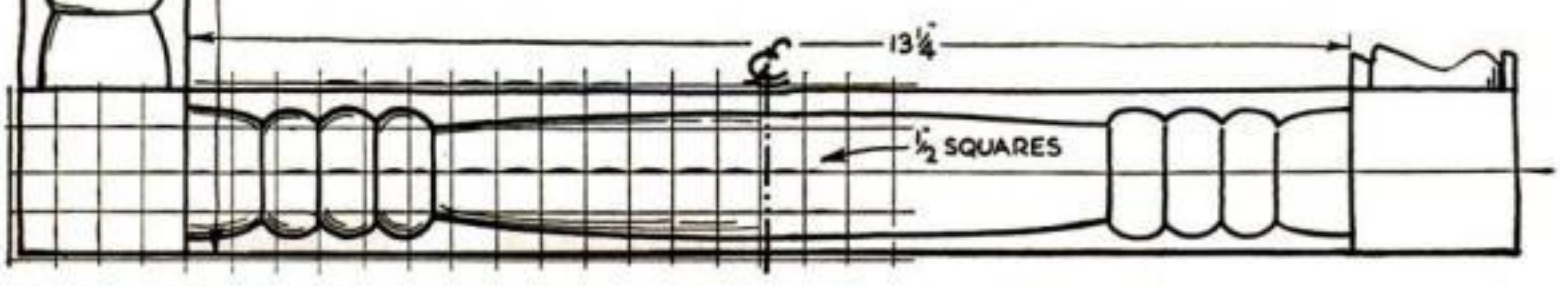
Two pieces are glued up with paper between for turning, sanded in the lathe, and then split apart. Sand the blocks and flat parts, and then assemble the pieces as shown above



By JOSEPH ARONSON

ONE of the mirrors that enjoyed great popularity among Americans of an earlier day had an oblong frame adorned with half turnings. The glass was usually framed at the top by a muntin bar, and there was a picture in the upper panel. These mirrors ranged from ornate gilt and carved specimens to the simple yet decorative example that inspired the design illustrated, which will fit well with many modern furnishings.

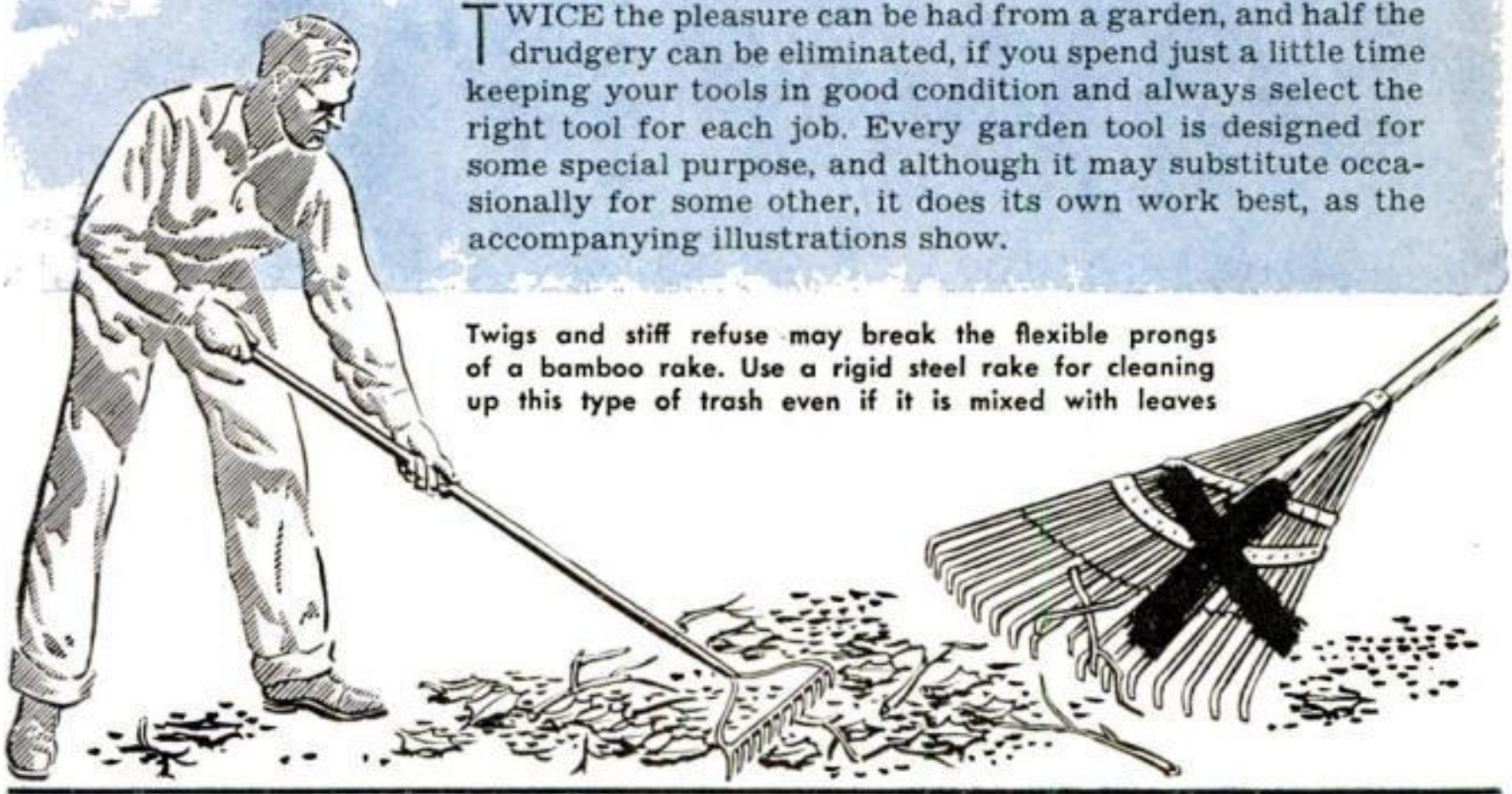
The basic framework consists of four flat members doweled together at the corners. Rabbet the short ones and stop-rabbet the long ones. After joining them, chisel out the corners. Half turnings are made by gluing up two pieces with heavy kraft paper between and turning them as a single piece. After sanding well, split the square gently at the paper with a wide chisel. Glue the half turnings on and fill the corners with the corner squares; then glue the muntin bar in place. A copy of an old print is pasted in the top section.



YOUR VICTORY GARDEN TOOLS

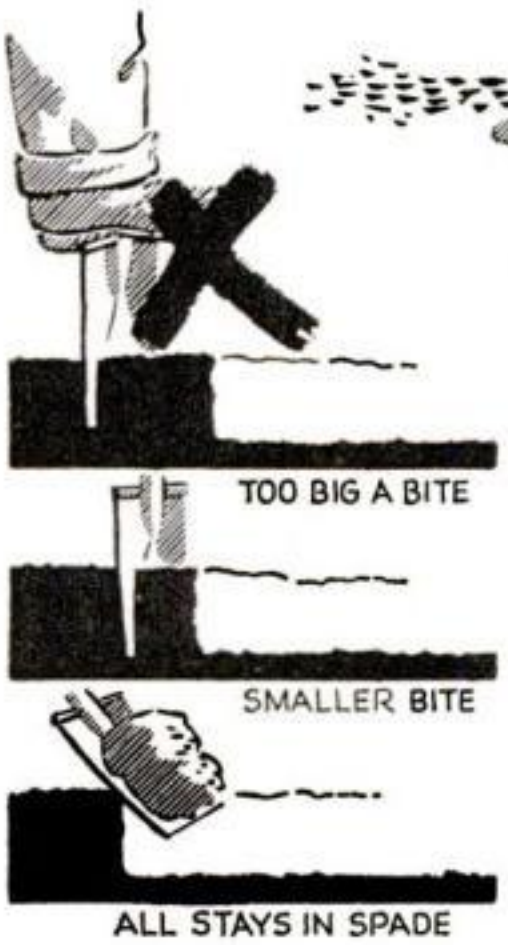
and How to Use Them

TWICE the pleasure can be had from a garden, and half the drudgery can be eliminated, if you spend just a little time keeping your tools in good condition and always select the right tool for each job. Every garden tool is designed for some special purpose, and although it may substitute occasionally for some other, it does its own work best, as the accompanying illustrations show.

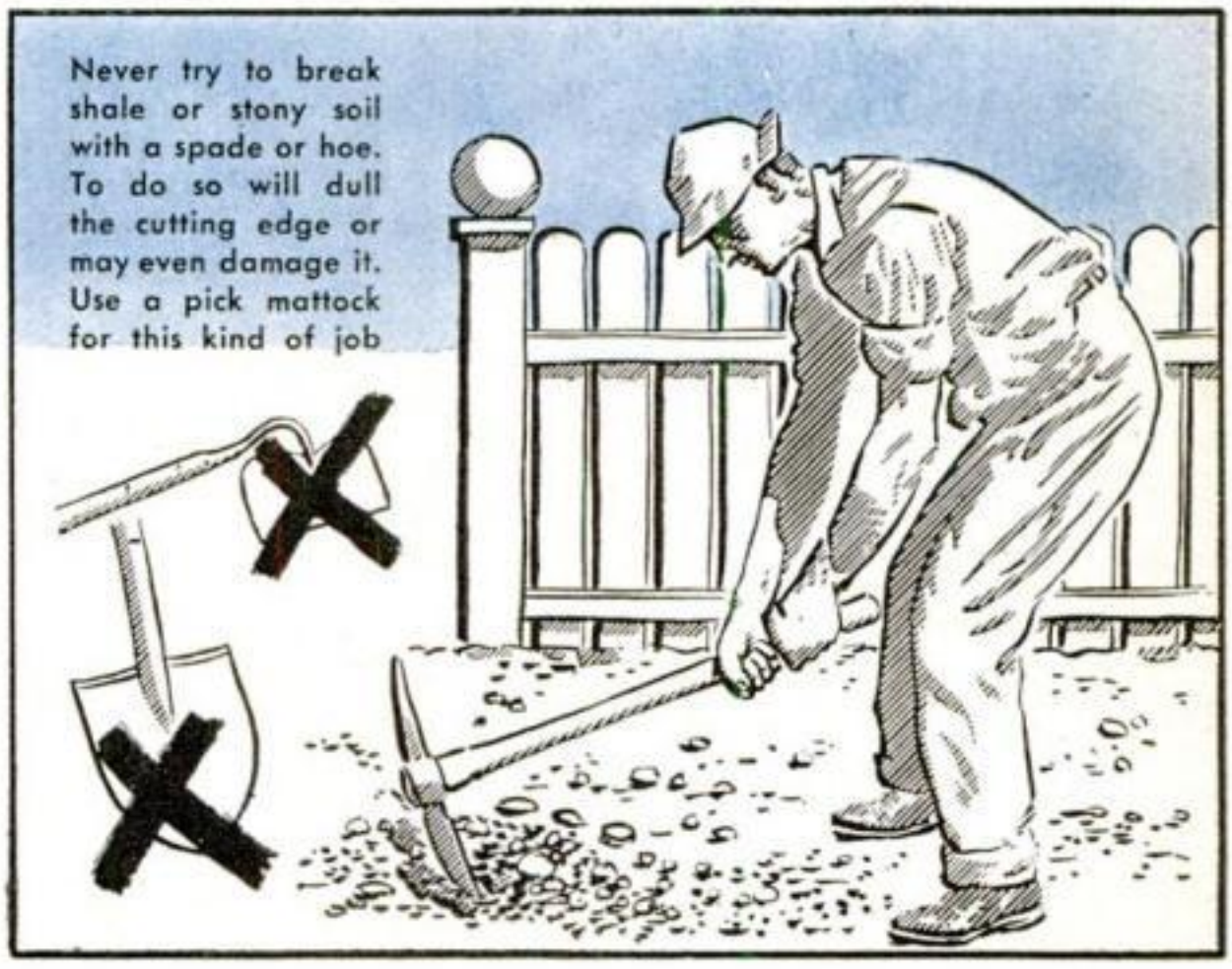


Twigs and stiff refuse may break the flexible prongs of a bamboo rake. Use a rigid steel rake for cleaning up this type of trash even if it is mixed with leaves

Don't use a digging tool as a crowbar for prying stones or as a sledge for driving stakes. The strain may break it

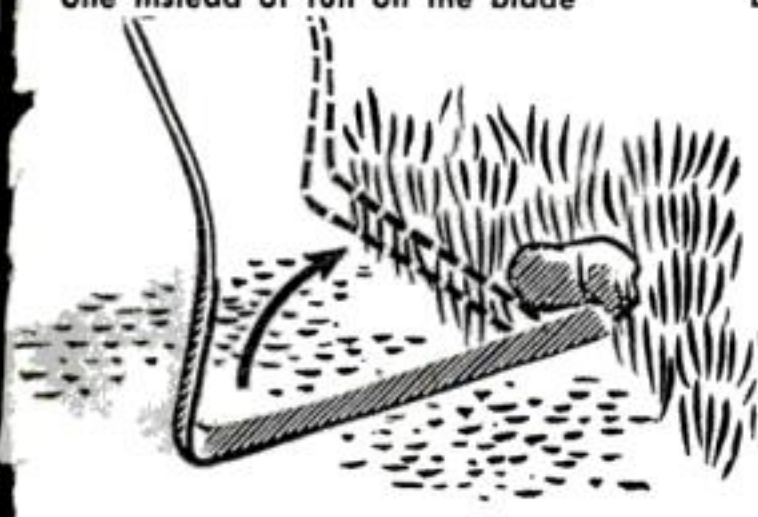


Take moderate bites with a spade. Just enough to pry loose and lift easily will be right Oversize bites may break the spade handle

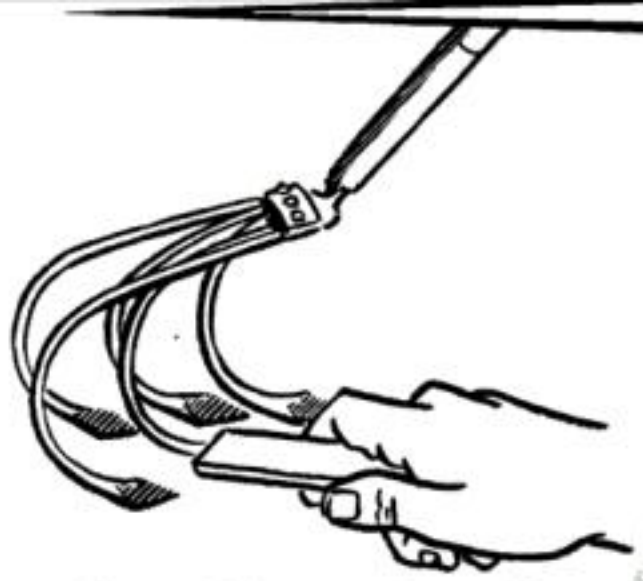


Never try to break shale or stony soil with a spade or hoe. To do so will dull the cutting edge or may even damage it. Use a pick mattock for this kind of job

Hidden stones will cause less damage to a grass whip if you cut narrow swaths. Any blow on a stone will then be a glancing one instead of full on the blade



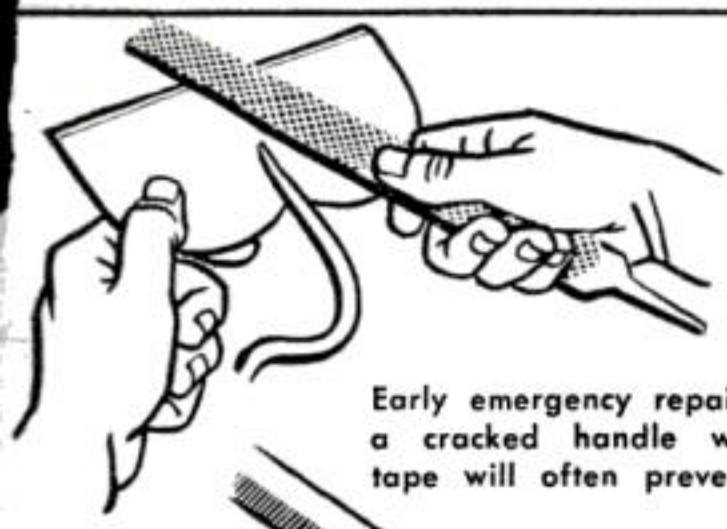
For clearing ground studded with sapling and brush stubble, use a sturdy weed cutter. Its heavy, saw-toothed blade supported at both ends will make quick work



Clean off dirt, scraping with a stick, and grease the tools if they are to go long unused

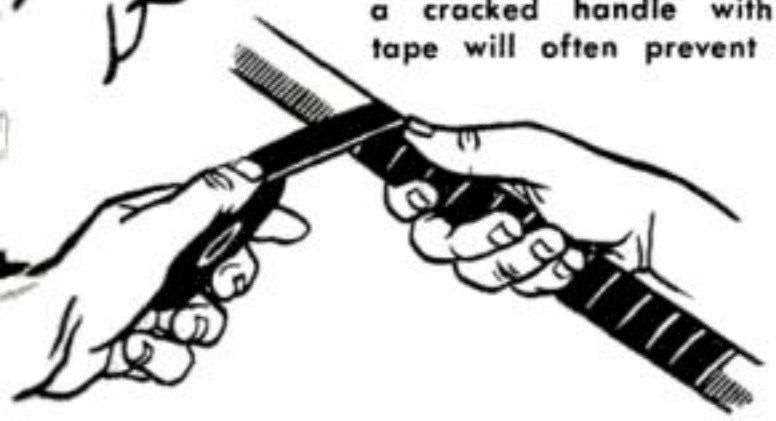
STORING

KEEPING THEM IN REPAIR

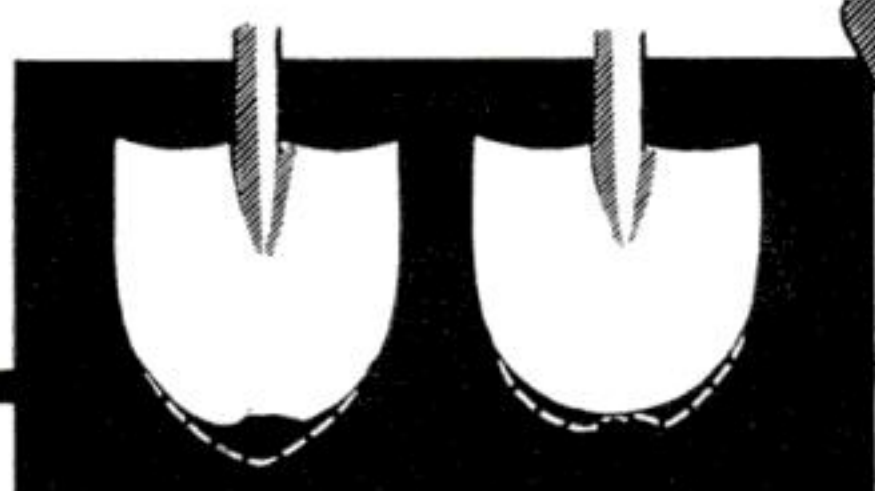


More work can be had from hoes, spades, cultivators, and other edged garden tools if they are kept sharp with a common file

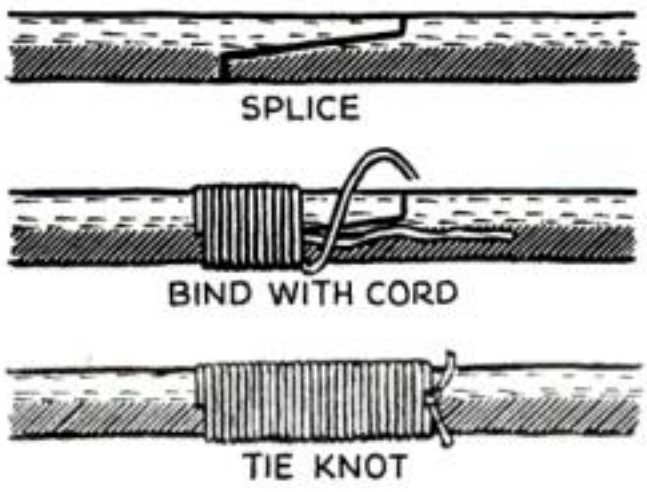
Early emergency repairs made to a cracked handle with friction tape will often prevent a break



If a handle persists in working loose in its socket, drill a hole through the two parts and bolt them together

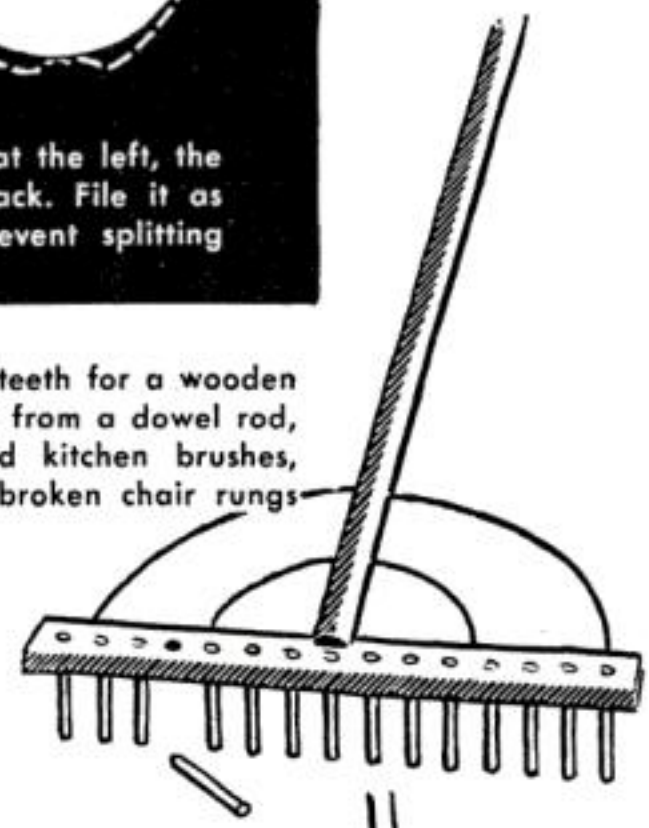


When a shovel is worn as at the left, the blade is more likely to crack. File it as shown at the right to prevent splitting

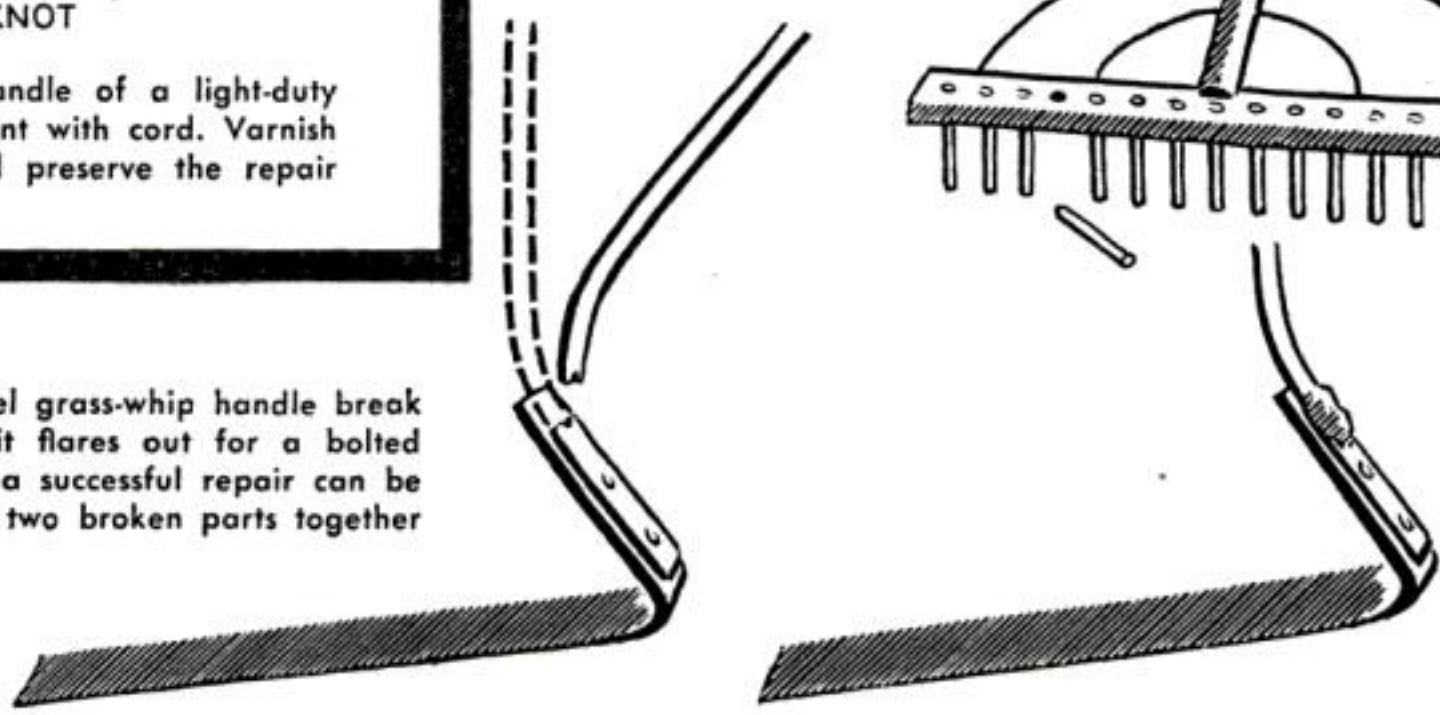


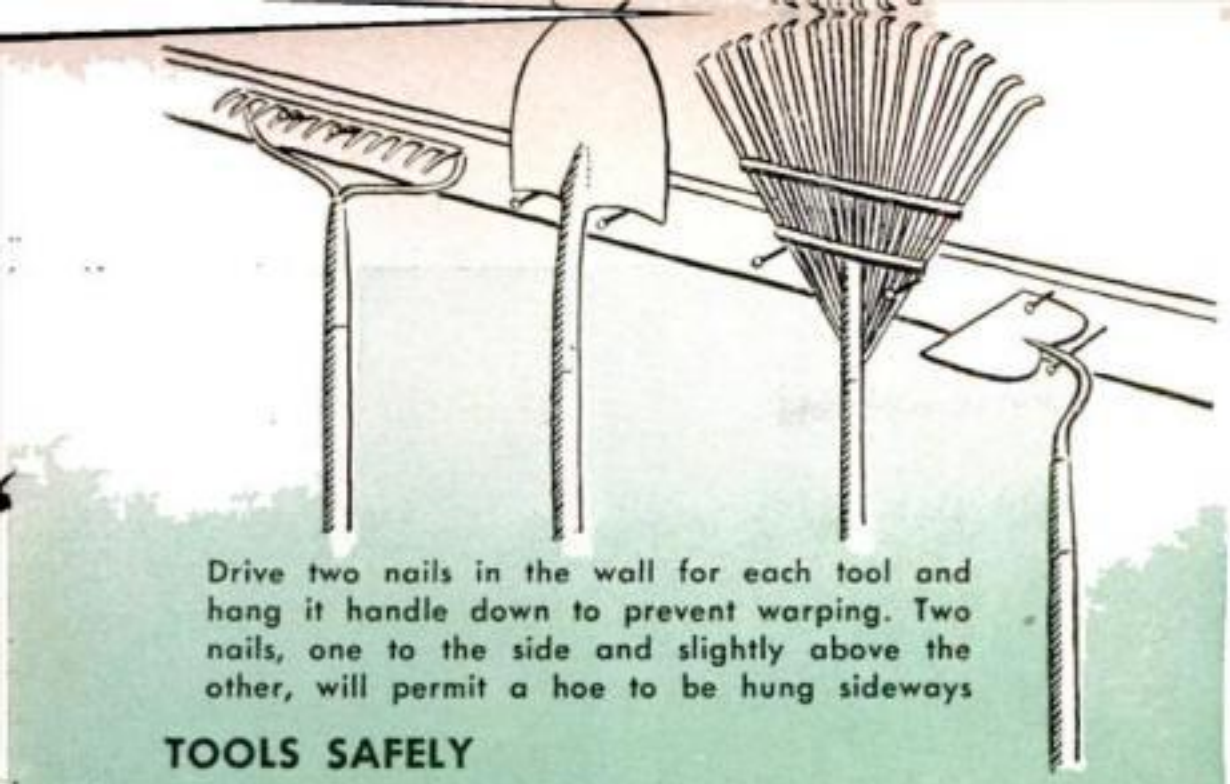
Splice the broken handle of a light-duty tool and bind the joint with cord. Varnish over the binding will preserve the repair

Good replacement teeth for a wooden rake can be sawed from a dowel rod, the handles of old kitchen brushes, or even pieces of broken chair rungs



Should a springy, steel grass-whip handle break at the point where it flares out for a bolted joint with the blade, a successful repair can be made by brazing the two broken parts together



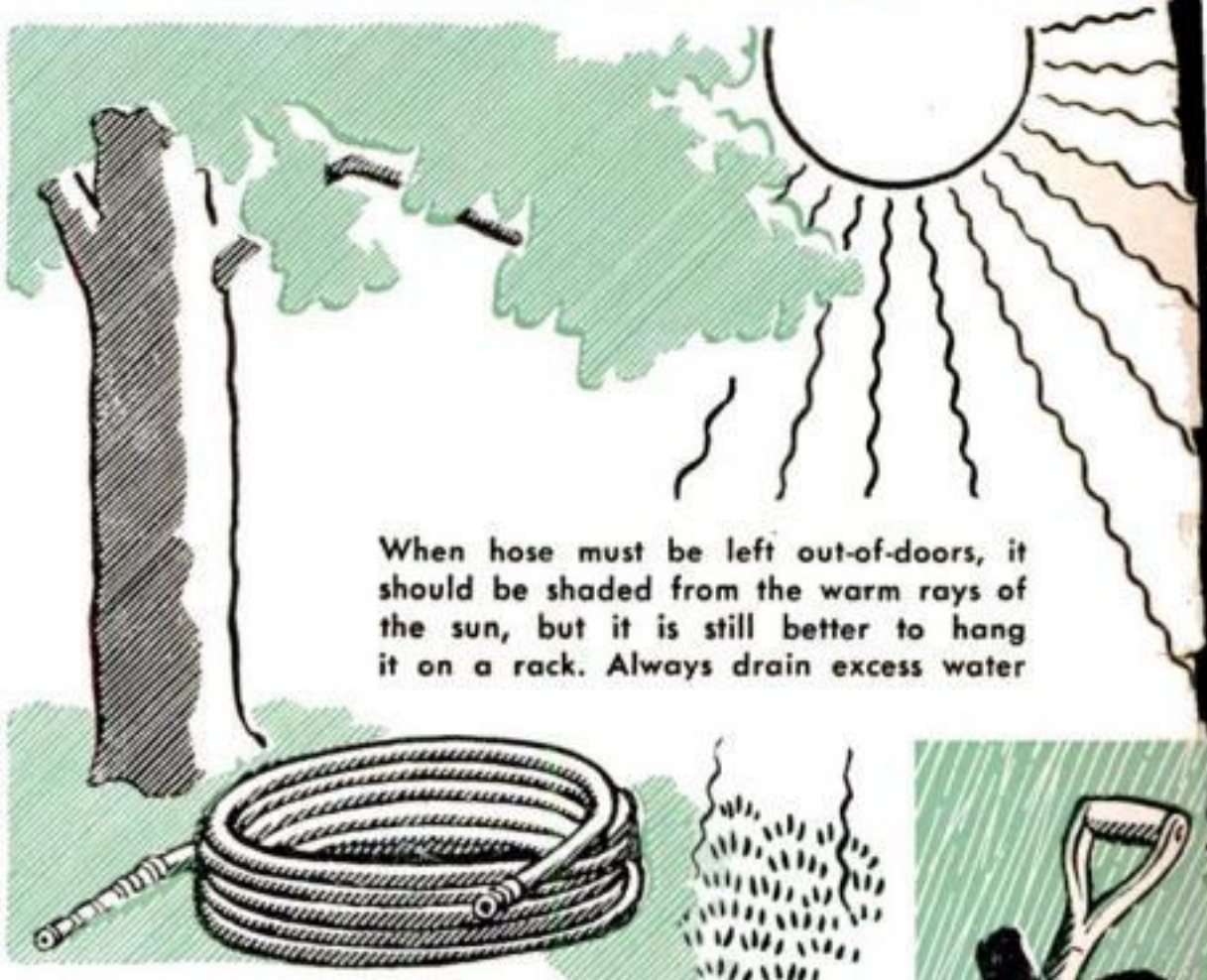


Drive two nails in the wall for each tool and hang it handle down to prevent warping. Two nails, one to the side and slightly above the other, will permit a hoe to be hung sideways

TOOLS SAFELY

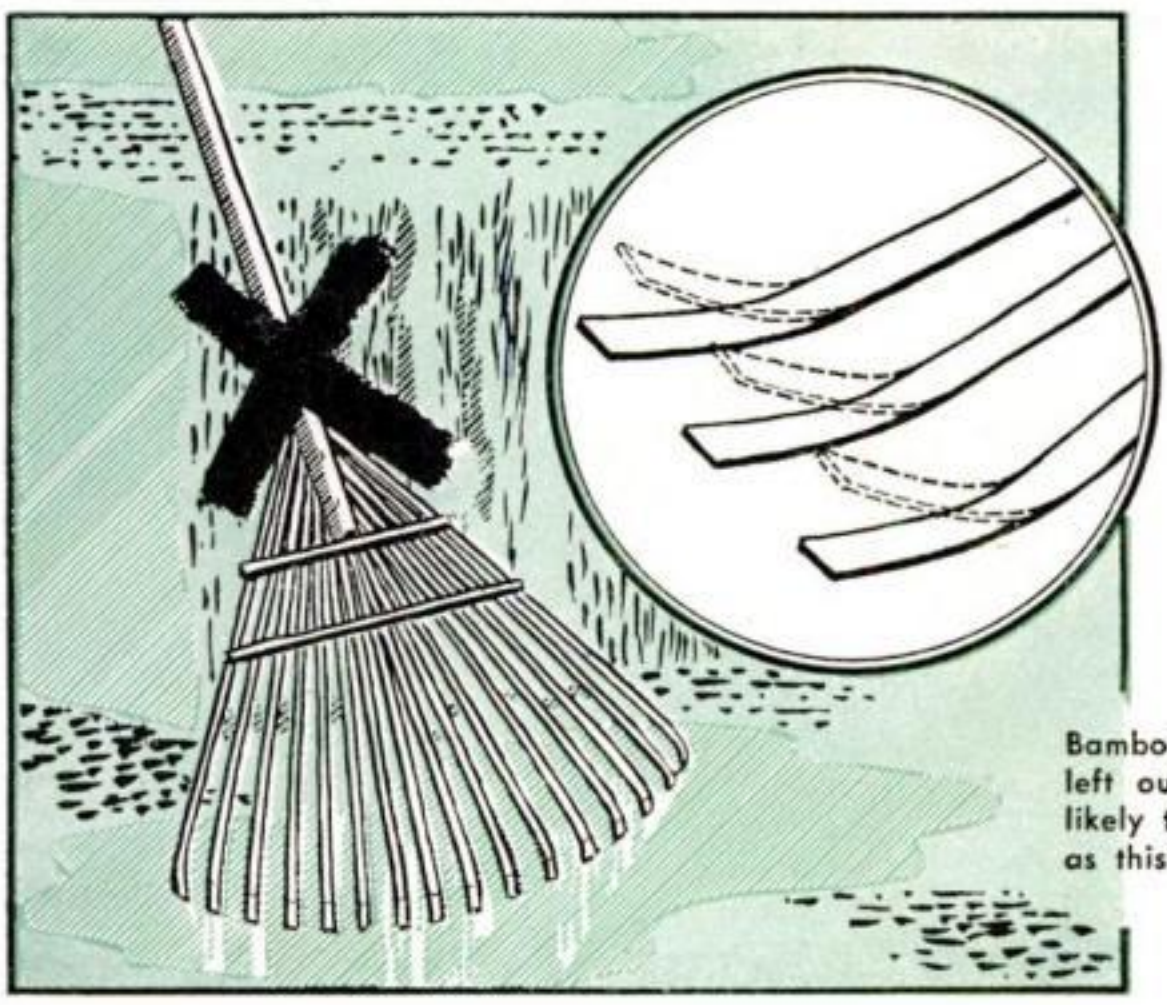
Lawn rollers and all metal wheels should be raised off damp ground to keep them from rusting. Stone slabs or bricks will serve well

If an open-socket shovel or similar tool is used on wet jobs, seal the exposed end of the handle with two or three coats of waterproof paint and wax the remainder of the handle



When hose must be left out-of-doors, it should be shaded from the warm rays of the sun, but it is still better to hang it on a rack. Always drain excess water

PROTECTING THEM FROM EXPOSURE



Soaking rain and baking sun will shorten the life of any tool by encouraging rust and rot. When a lengthy pause is taken in a gardening job, tools should be put back in the tool shed until needed again

Bamboo lawn rakes should always be kept dry—not left out in rain, especially where their tips are likely to get a prolonged soaking. Such exposure as this may cause the bent tips to straighten out

HOMEMADE OUTDOOR GAMES

Provide Fun in Your Own Back Yard

BY JOE THERIAULT

YOU don't have to have a priority number to enjoy the sunshine. And it isn't necessary to travel hundreds of miles to have a good time. Around the outside walls of your home, on the sundeck or roof, in the back yard, and along the driveway you can try your ingenuity at games that will provide hours of amusement for every member of your family as well as your guests. With a little bit of this and a little bit of that you can make a variety of games that will give you fun and exercise all summer long!

The following games, although improvised and by no means orthodox, have been thoroughly enjoyed by my friends and myself. If they are not quite suited to your needs, it is likely that you can make some variations that will be equally pleasing.

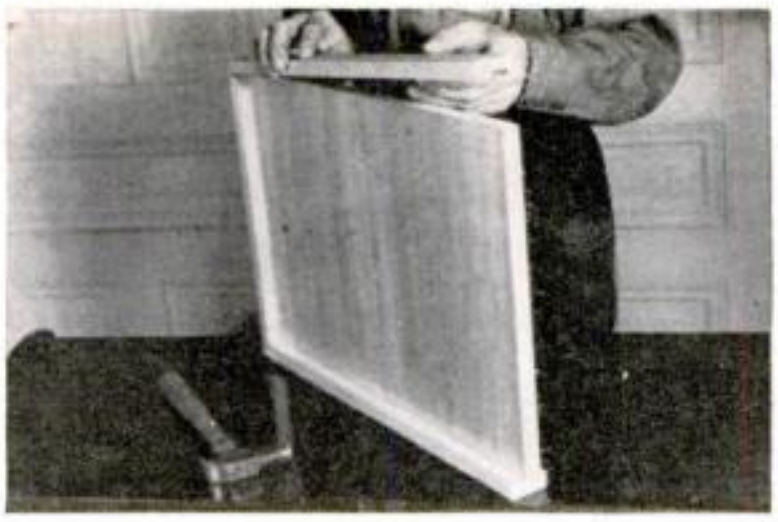
MIDGET GOLF. Without disfiguring your lawn, you can convert it into a nine-hole golf course in about 15 minutes. The simplest layout is to place the holes around the base of a shade tree. Dig out the holes with a small tin can or a transplanting tool, carefully removing the grass and earth, which can be returned at the end of the game. Then force a small can or flowerpot into each one of the holes.

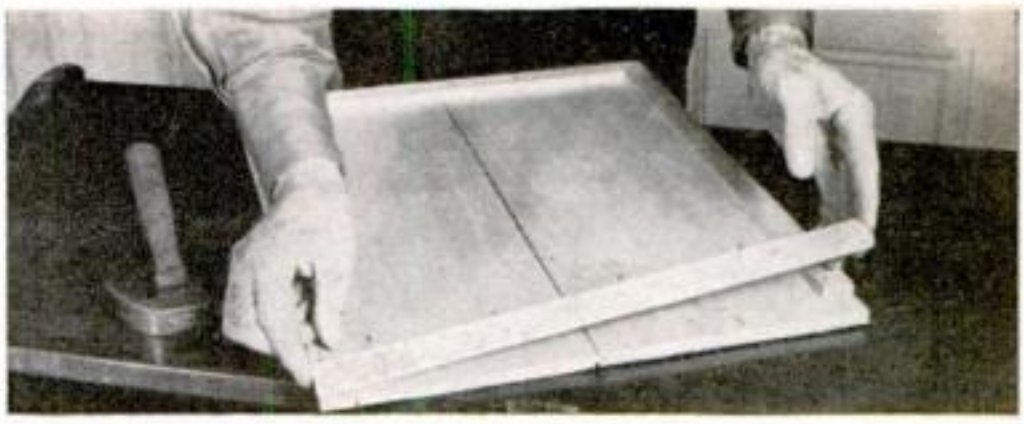
To make the game more interesting, scatter hazards around the approaches to the holes. Shingles leaned against small rocks make good bunkers; other shingles driven endwise into the earth add difficulty to the approaches. Plant a numbered flag at each hole by tacking a small triangle of cardboard to a 9" stick and tapping the stick into the ground. Putter, niblick, and ball are the only other items needed for this amusing game. You can play it with partners or singly—each man for himself—adapting the ordinary rules of golf to your space or making up your own set of rules.

After cutting holes for the midget golf course, set in small flowerpots

DART BOWLING. From a 3" bass plug or an oblong wood float you can quickly make a dart for playing a good muscle-bending game. First, remove any metal attach-

Dart bowling, at left, is a good scoring game. The dart is made from a bass plug or a wood float





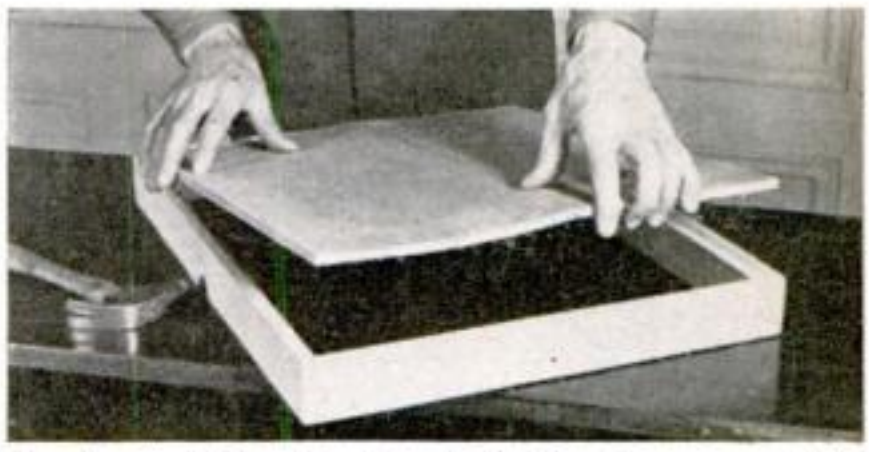
Material from an apple box is just right for the inner cover, which is shown being assembled in the photo above

How the bottom board is assembled. Make this longer than the hive so as to provide a landing place for the bees. Rabbeting of the strips is not necessary if power tools are not available

Equipment

bees. An entrance stick is used in cold weather to reduce the opening to the hive. The double lid, consisting of an inner and an outer cover, affords maximum protection against summer heat. **Apple-box stock is just** the right thickness for the inside cover, and ordinary lightweight asphalt roofing makes a good outside sheathing. It should be quite warm when it is bent over the edges, so that it will not crack.

Hives and supers should be painted on the outside only. Give them two or three coats of white outdoor paint before installing your bee colony. If ready-made frames are not available, you can make them as shown in the drawing.—BENJAMIN NIELSEN.



The inner lining is placed inside the cover. This provides adequate protection against summer heat

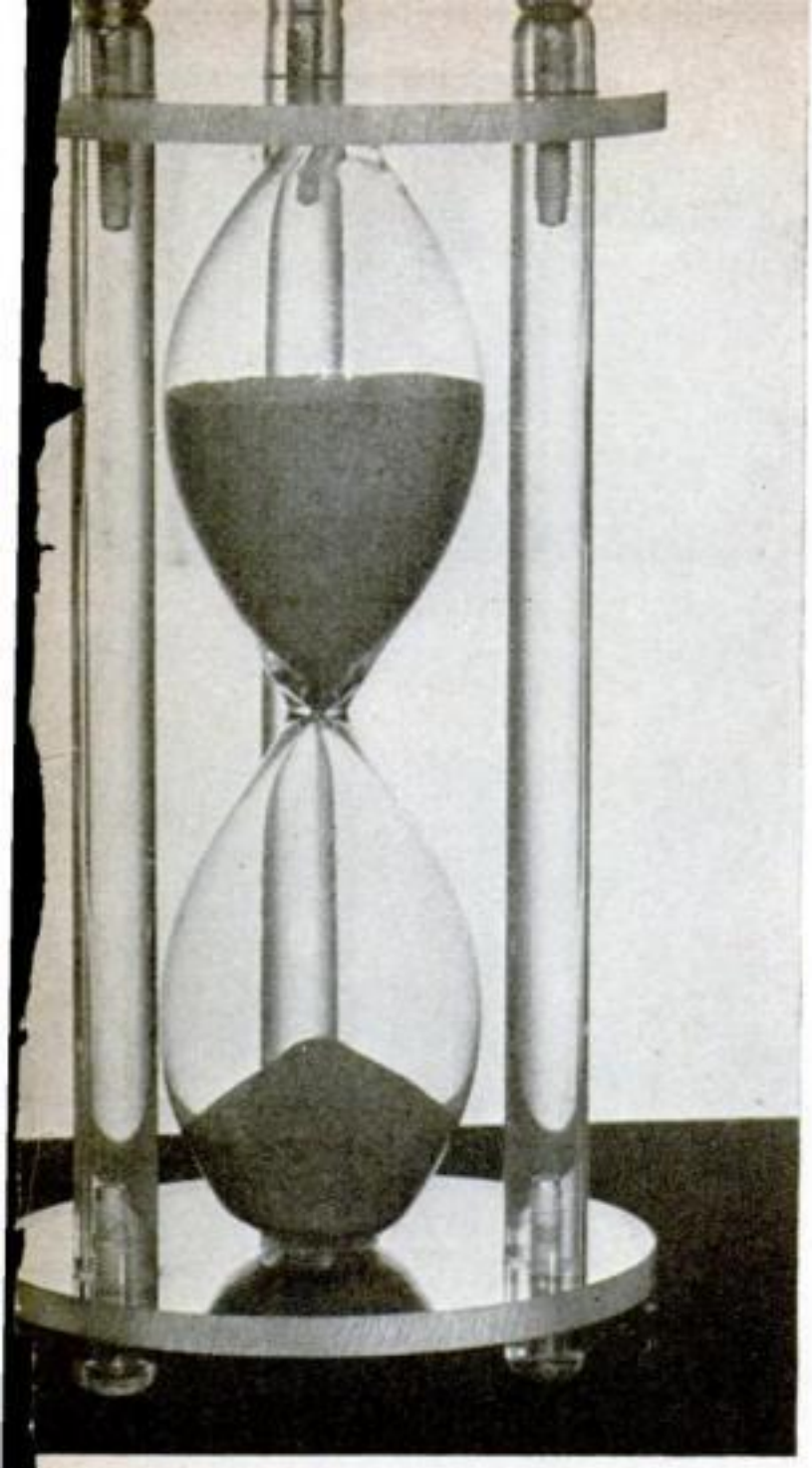
As a further protection, a layer of asphalt roofing is tacked securely over the assembled cover

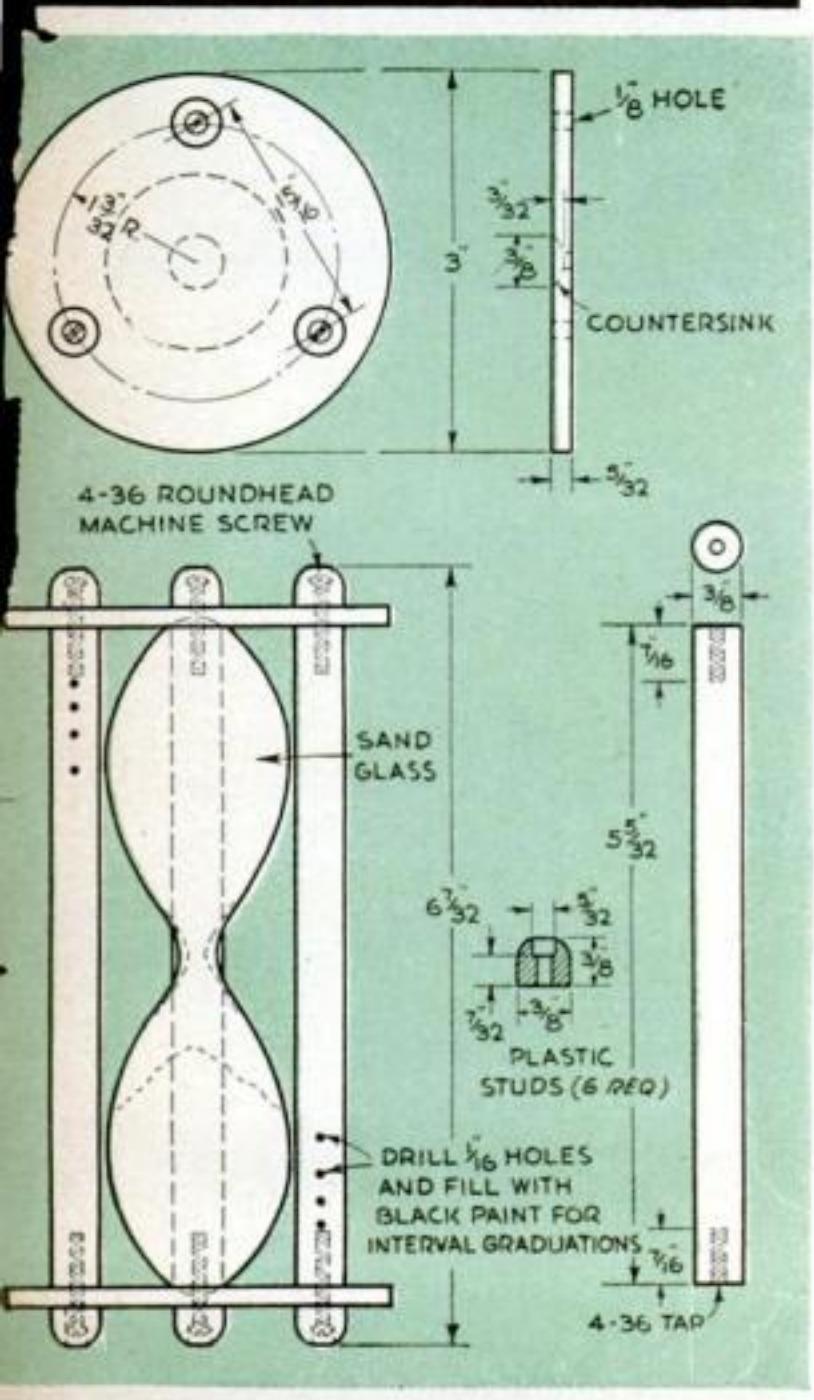
WIRING CONVENIENCE OUTLETS [*ELECTRICITY*]

In conformity with the recommendations of the National Electrical Code (1940 edition), convenience outlets which supply current in a kitchen, laundry, pantry, dining room, or breakfast room for other purposes than lighting should be wired on separate circuits and with wire not smaller than No. 12. This allows for the use of flatirons, refrigerators, waffle irons, washing machines, and other accessories that draw considerable current.

One outlet is suggested for every 20 linear feet, or fraction thereof, in the total distance around the room. As far as possible, the outlets should be spaced equal distances apart. Nonmetallic overhead receptacles should be installed in laundries and similar damp locations. These requirements are obviously intended to eliminate the dangers arising from the use of flexible-cord wiring in homes, and from overloading of branch circuits.

POPULAR SCIENCE MONTHLY SHOP DATA





HW 342

TWO-EVENING

THREE USEFUL ITEMS FROM BITS

Average time: 4 hours.

HOURGLASS WITH PLASTIC FRAME. This piece, having a scale graduated between one and 15 minutes, will be useful in the kitchen as well as in the darkroom. A 15-minute sand glass can be purchased at an optical store. Small pieces of scrap plastic are used for the disks, feet, and posts. Scribe the circles with dividers and cut the disks full; then finish by sanding to the line. Drill holes part way through the centers and countersink them to receive the ends of the hourglass. Spot three holes for the screws, as shown in the sketch.

The six feet are turned in a lathe and can be cut from the same stock used for the posts. Drill 1/8" holes through the feet and countersink one end to receive the round head of a brass machine screw. Round the edges of the countersunk ends. Now cut the three posts, being sure they are flat and true at both ends. Drill both ends to a depth of 7/16" with a No. 44 drill and thread with a 4-36 tap. When using the tap be careful to avoid binding by removing chips. This prevents stripping of the threads. When assembling, have the glass slightly loose to avoid breakage. Mark a scale on one post in time intervals to suit. Drill small holes at the marks and rub black paint into them for ease in reading.

Average time: 4 hours.

BACHELOR'S CATCHALL. A wife, too, will appreciate this transparent case of clear plastic and walnut for keeping her spouse's cuff links, shirt studs, tie clasps, and collar buttons all safely in one place. Before turning the walnut base, cut a 3/8" deep slot in the stock for the partition. Trim the stock on the band saw and mount it on a screw center after inserting a tight spline in the groove to prevent the shoulders from breaking. Turn it to the dimensions shown on the drawing; then finish it with two coats of white shellac and wax. Fit the round plastic wall, which is cut from tubular stock, to the base and cement in place.

Use a screw center when turning the walnut cover, first cutting the inside ring to fit the plastic wall, then reversing and cutting the rounded rim and the inside rabbet for the plastic top to fit in. In turning the knob, follow the dimensions on the drawing and finish the piece in the lathe. Center an undersized hole in the bottom of the knob for the screw. Finish both pieces with white shellac and wax.

The plastic portion of the top is cut slightly oversize from flat stock and trial-fitted to a tight fit in the rabbet of the wooden rim with the aid of fine sandpaper on a disk sander. Drill a hole in the center for the screw that fastens it to the knob.

PROJECTS

OF PLASTIC AND WOOD

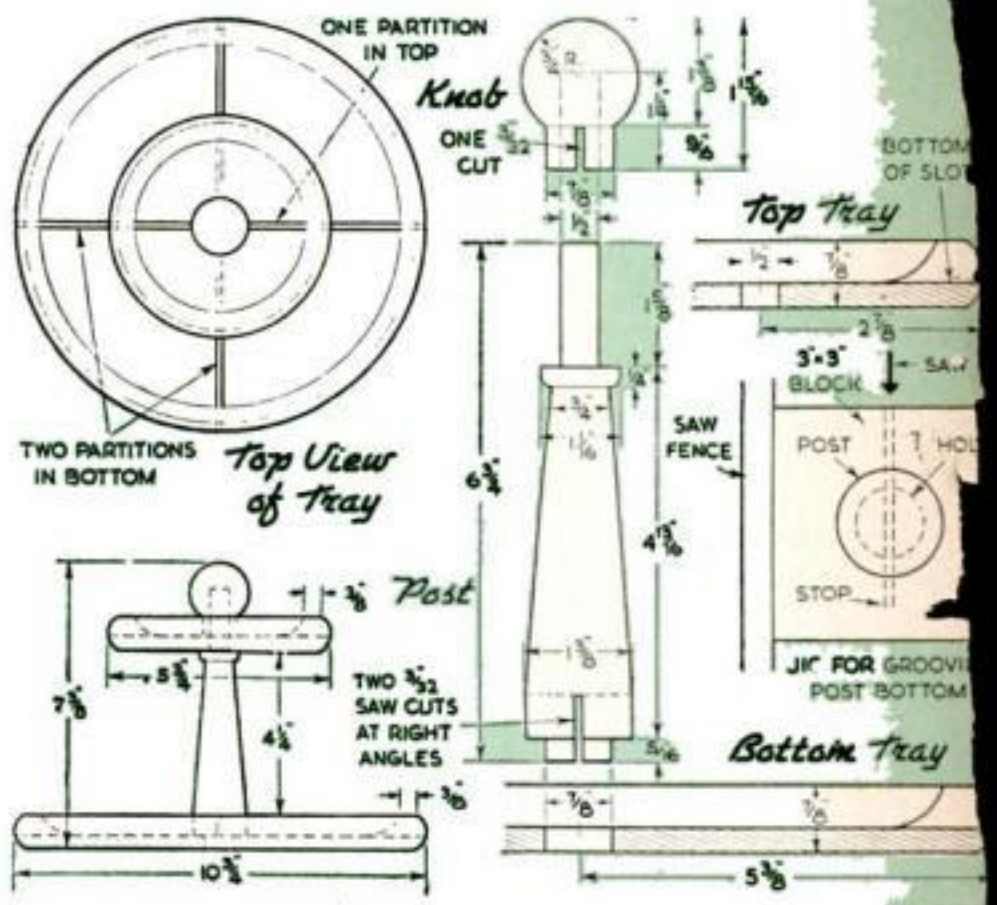
Average time: *5 hours.*

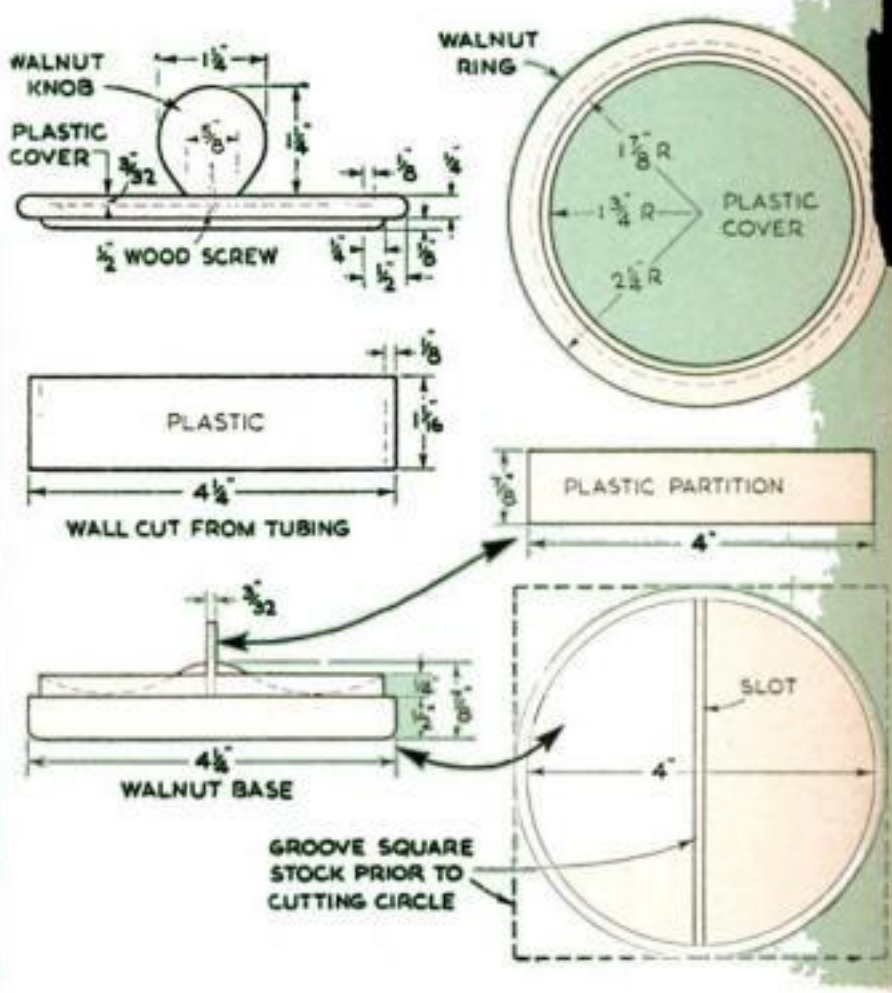
TIDBIT TRAY. This handsome server, suitable for holding tasty snacks and canapés, is made of mahogany except for the partitions, which are of contrasting walnut. Before turning the top tray, cut the grooves for the single partition in the stock and fill the slots with tight-fitting splines. Bandsaw into shape and turn on a faceplate, rounding the rim as shown. Before removing the piece from the lathe, drill a ½" hole for the dowel in the end of the post. Finish on the lathe with two coats of clear lacquer. Repeat the procedure for the bottom tray, cutting an extra groove for the second partition.

Roughly shape the knob on the band saw; then mount it in a chuck and turn the shank and lower half of the ball. Drill the hole for the post joint and insert a snug-fitting dowel to hold the wood in the chuck while the other half of the ball is being turned. Finish this also with two coats of lacquer. In cutting slots for partitions in the post and the ball, use the jig illustrated for steadying against the saw fence.

Partitions, shaped on the band saw and sanded to the contours of the rims, are fitted into the saw cuts. Glue all parts. Use four brads at the bottom.

ALL PROJECTS
DESIGNED BY ERNEST R. DEWALT





HW 343

Corner Joints Are Speedily

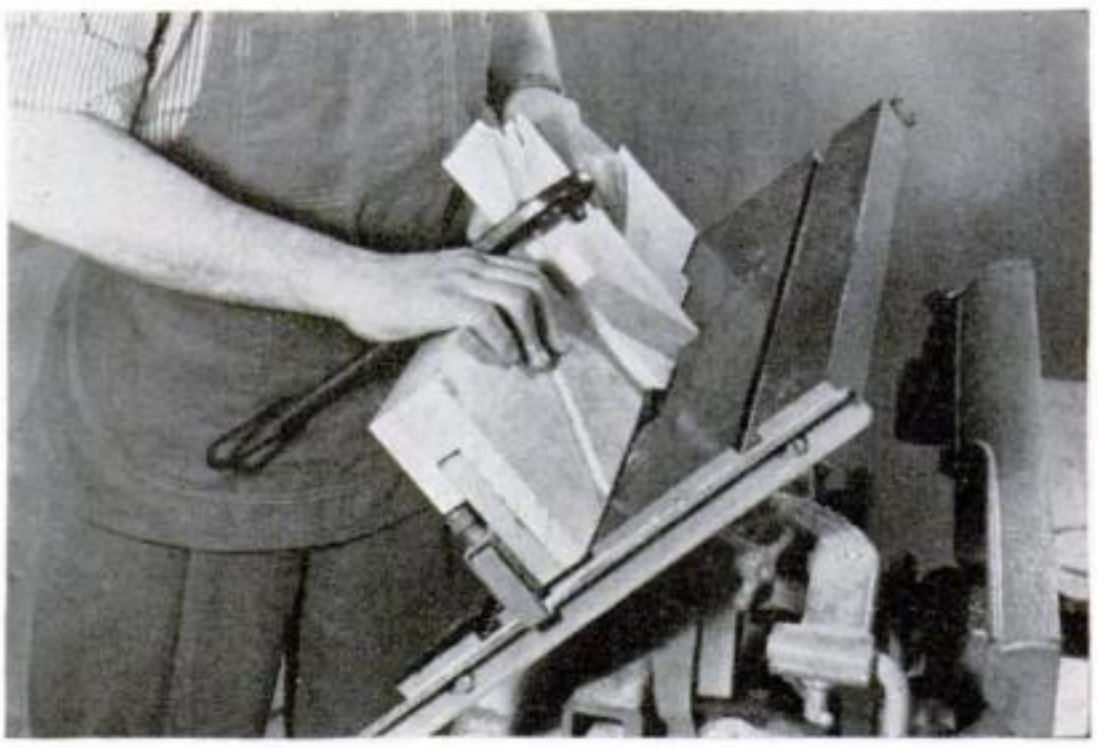
By EDWIN M. LOVE

ANYONE owning a circular saw is equipped to make reinforced corner joints that would be extremely difficult to execute by hand. Splined miters across the face of stock, much used for frames, are easy to make on such a machine. Similar miters in the edges of material to be used for box sides are also quickly cut. The more elaborate mitered rabbets and lock joints are not much more difficult.

There are certain hazards normally present in grooving the end of a piece of wood, because it must be slid against the ripping fence in an awkward vertical position, and may catch in the saw opening of the inset. Consequently a jig should be built to hold stock firmly upright while end cuts are being made.

What type of jig is used? An end-sawing jig for the home shop that can be adapted to a variety of work and will prove a useful, permanent accessory for the circular saw is shown in the drawings and in the photographs on this page. Built of scrap wood, such a jig has three simple parts: a wooden auxiliary fence to be screwed fast to the ripping fence, an inverted U-section built to slide without play on the auxiliary fence, and two 45-deg. wooden guides fastened to the face of the sliding section. Dimensions may vary from those shown in the drawing so long as the section clears lock nuts or other obstructions on the ripping fence and holds the work securely. When assembling a jig, insert a piece of heavy paper between the back guide and the spacer to provide sliding clearance on the auxiliary fence.

How is the jig used? To groove a face-mitered piece for a spline, mount a dado head of the required width on the saw arbor and adjust for the depth of the cut. Place the jig on the auxiliary fence and lock the latter with the face of the jig at the proper distance from the saw. Screw one 45-deg. guide in place and clamp the stock to the jig against this guide. Cut the groove in the miter by pushing the jig along the fence. When one end of each piece has been grooved, remove the guide and attach the other one. This will insure flush fitting of the joints because all face sides can be kept against the jig. If a



A jig is used in grooving a face miter joint for a slip tongue, as above. Edge miters are grooved for splines either with the same jig (below) or with the miter gauge as shown in a drawing

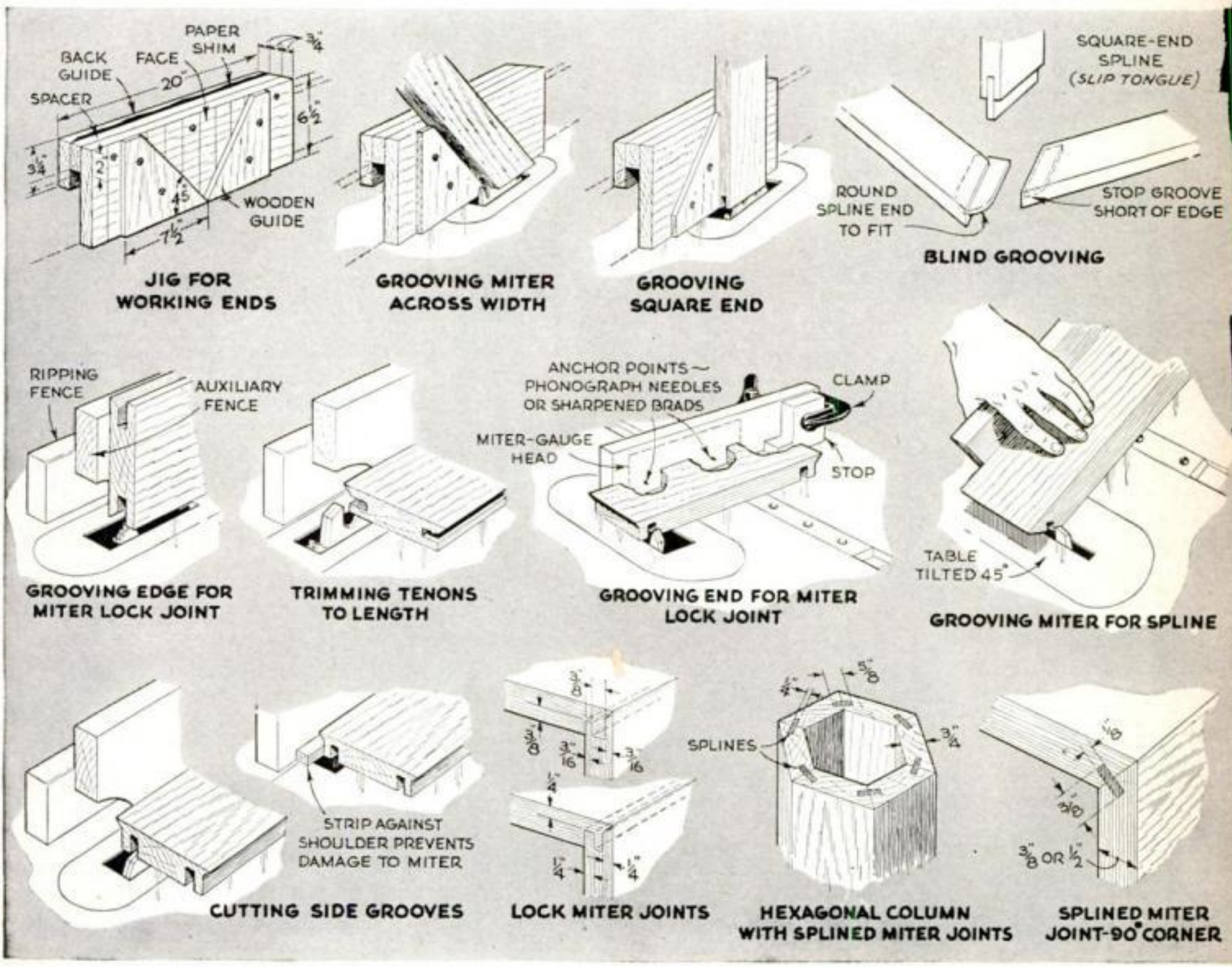
Made on the Circular Saw

molding is to be splined, regard the flat back of the molding as the face side.

Should the rip fence on your circular saw allow the auxiliary fence to be transferred to the other side, all the grooves can be cut with the pieces inclined forward. This also facilitates the making of a blind groove in which the spline is hidden from the outer edge. In a face-mitered joint, a spline with grain running crosswise projects at both ends and is trimmed flush after assembly. In a hidden-spline joint, the outer end is rounded to fit the arc of the saw cut.

How is a mitered rabbet joint cut? Tilt the arbor or table of the machine at 45 deg. If the under corner of the insert opening rubs, file it clear or make a wooden insert. Set the face of the jig lightly touching the dado head, adjust the saw for depth, and screw on a guide in a vertical position. Clamp a piece of waste to the jig and make trial cuts until a sharp, 45-deg. lip is left on the face side; then proceed with the ends to be joined. Finally, level the table and rabbet the ends by

After the miter for a mitered rabbet joint has been cut on a tilted saw table, the rabbet can be cut with the miter gauge



using a miter gauge in the usual manner.

Can mitered lock joints be cut? Yes. On ¾" stock use a ¼" wide dado head, making miter cuts as for a miter rabbet joint. Then level the table and, supporting the material in a vertical position, cut a groove ¾" deep in one end ¼" from the face. Use the miter gauge to cut the square-end tenon to length and also to cut a mating miter, groove, and tenon in the joining piece. The cross-grained edges of the joint can be strengthened against splitting off in assembly by reducing the thickness of the tenons. A 3/16" groove can be cut with two passes of a ⅛" outer dado blade. A tenon ⅛" thick will fit a one-pass groove. Lock joints mitered longitudinally use the same cuts, but the work is slid lengthwise along the ripping fence.

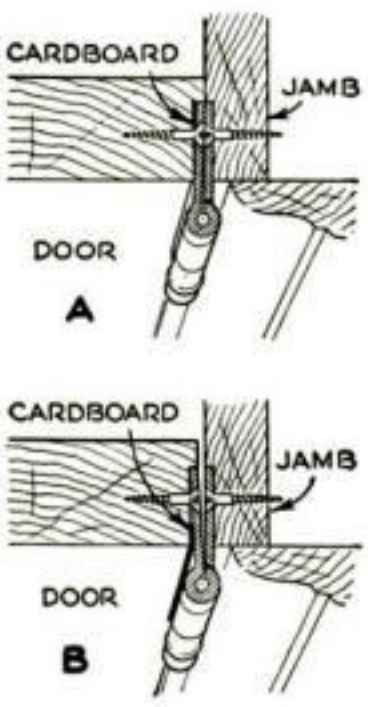
How are splined miter joints cut? Such joints are made in the ends of boards with the table or saw arbor tilted 45 deg. for mitering the ends. The fence is then used as a length stop in connection with the miter gauge while the groove is cut at right angles to the face of a miter. A still better method is to use a board screwed to the gauge head and fitted with points to prevent creeping, as shown in the drawing. This accessory is also useful when cutting cross grooves for lock miter joints. A notched stop block bears against the rabbet shoulder so as to avoid damaging the sharp edge of the miter.

To groove a corner for a reinforcing spline, use two 45-deg. guides on the jig. Clamp and saw both frame members together

When grooves for a spline are cut in miters along the long edge of two boards, tilt the table or arbor 45 deg., mount a dado head, adjust the fence, and slide each mitered edge against the fence while cutting its groove. For thin stock, use an ordinary saw blade, shaving a hardwood spline to fit. Aside from affording more gluing surface, splined miter joints help in clamping because there is no slipping of the ends past each other when pressure is applied.

FREEING BINDING DOORS

[SHIPSHAPE HOME]



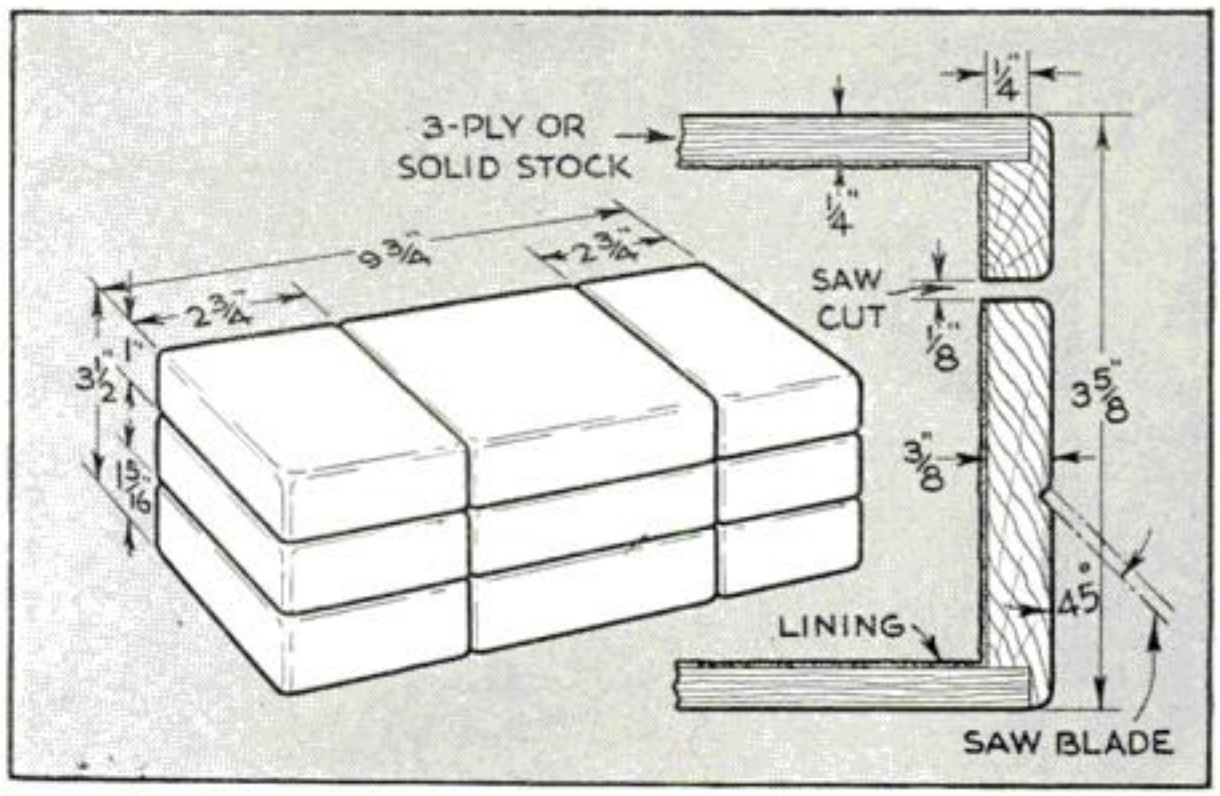
IN OBSTINATE cases that other means have failed to remedy, remove the hinge pins and lift the door down. Unscrew the hinge leaves from the jamb. Chisel a thin shaving from the bottom of each gain. Screw the leaves back in place and replace the door in its opening. If the lock edge still binds, loosen the door hinge leaves and slip thin cardboard strips behind the outer edges as at *A*. Tighten the screws again.

If the door is hinge-bound after this, slip the cardboard under the hinge leaves from the joint side as at *B*. Should it prove absolutely necessary to remove some wood, plane the binding edge to give not more than 1/16" clearance.

POPULAR SCIENCE MONTHLY SHOP DATA

Attractive Glove Box Built with Splined Corner Joints

START this box by cutting a strip 3′ long for the sides and ends. Rabbet its long edges to receive the top and bottom pieces, which may be cut from either plywood or solid stock. Saw the sides and ends roughly to length by mitering one end of each; then bring them to exact dimensions by mitering the other ends. Bevel the edges of the top slightly so as to secure a wedging action. Now cut the grooves for the splines and make the splines, following the directions given in the preceding article. Cover all joints with a thin coat of glue, allow it to dry for a few minutes, and assemble the box. Clamp it together, forcing in the top and bottom pieces; then true it up. Wipe off surplus glue with a damp cloth.

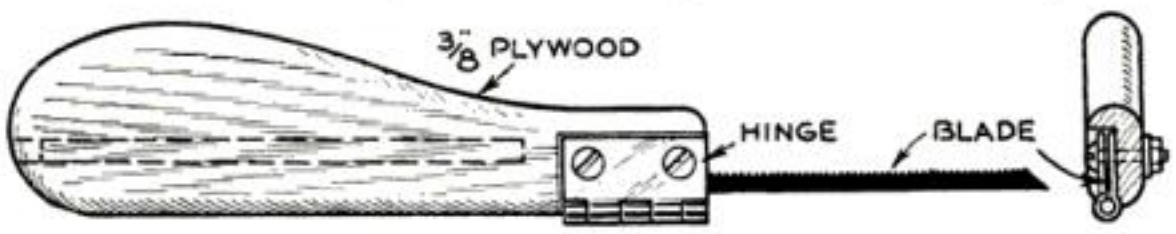


Shallow saw cuts make the surface lines on the sides, ends, and top

Score the surface lines on the circular saw, having the table tilted at an angle of 45 deg. Round and smooth all corners and edges by hand. Cut the box into two pieces at the point indicated in the drawing. It can then be given a natural finish or a coat of enamel. Line the interior with leather or velvet to add a neat and professional touch.—E. M. L.

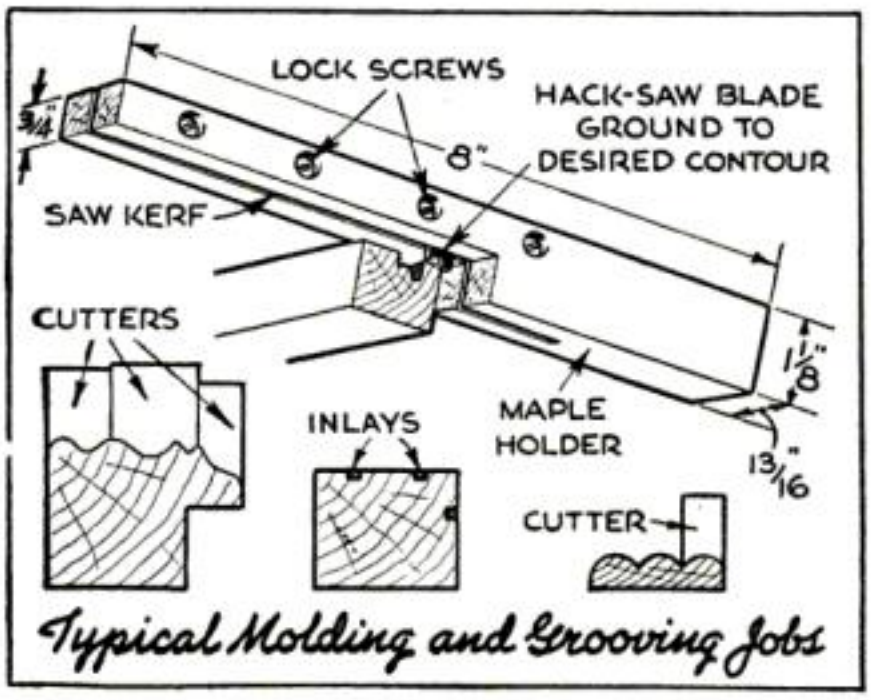
Hinge Used on Handle to Grip Blade of Tiny Keyhole Saw

A DIMINUTIVE keyhole saw for use in model-making and other delicate tasks can be made from workshop odds and ends. The handle is shaped from 3/8" plywood, and a rectangular section is rabbeted to receive one leaf of a 1/2" by 1" brass hinge. Two 3/16" holes are drilled in the recessed area to match those in the hinge. Then a section of a coping-saw blade is laid in the hinge and both leaves are bolted to the handle with machine screws so as to clamp the blade securely. If a hole about 3/16" in diameter is drilled in the opposite end, a handy receptacle will be formed in which additional blades can be kept at hand.—A. ALBANESE.



Hack-Saw Blade Serves as Cutter in Simple Hand Molder

THE home craftsman who has no power shaper may still make moldings by using an old hack-saw blade for the job. Grind the blade to the desired shape and carefully sharpen the edges. In a stepped handle bore a set of holes and saw across them to provide a slot for holding the blade. Insert the shaped cutter and tighten it in place with small bolts and nuts. By using the inside shoulder of the handle as a guide, the cutter can be drawn across the surface of the molding for forming the corresponding contours. A number of cutters of different shapes can be ground as need arises, and as many may be inserted in the holder at a time as are required.—R. E. DAVIS.



IT'S EASY TO FINISH UNPAINTED FURNITURE

Simple Methods Used with the Proper Materials Will Enable You to Put a Lasting Coat of Beauty on New Pieces

By Fay Turpin

QUALITY of finish is the reward of painstaking effort, probably no more so on any job tackled by the home craftsman than that of painting or staining unfinished furniture. Yet there is no mystery attached to getting results worthy of a professional cabinetmaker, and even the rankest amateur need not hesitate to take advantage of the wide selection of unfinished pieces being offered—provided he is willing to give his work the time and care it requires.

Finishing unpainted pieces is not an easy job in the sense that it can be done quickly or haphazardly, but it does not demand difficult techniques. Following a few simple, fundamental rules is all that is necessary. And it means creating a piece you will like to have in your home instead of doing just a so-so job.

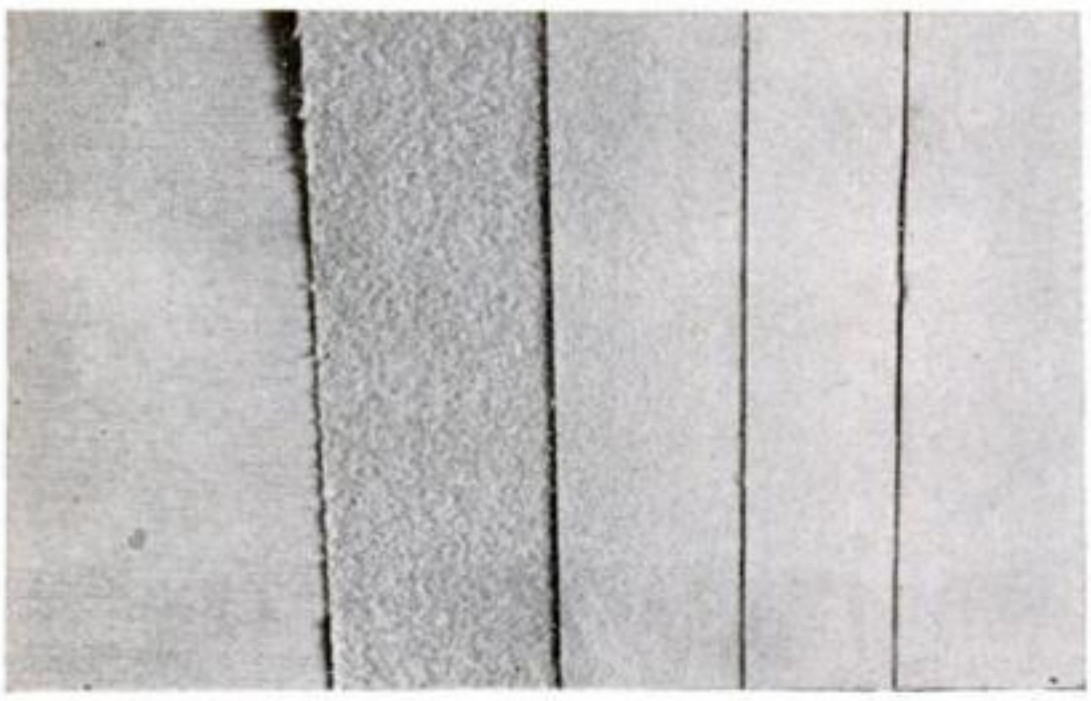
First, decide on the color and kind of finish you want. The former should harmonize with the existing decorative scheme of the room; the latter should be suitable for the type of piece—a living-room bookcase and a lawn chair call for different treatments. There is also the matter of wearing quality. A much-used piece, for example, needs a hard, impervious finish such as enamel or varnish.

Be sure to buy furniture made of a wood suitable for the finish you have chosen. If this is to be mahogany, walnut, oak, or a similar finish through which the grain shows, select a piece made of a wood that has an open and pleasing grain. If the finish is to be paint or enamel, the kind of wood makes little difference. For the newer soft finishes sometimes called blond, platinum, or driftwood, the smooth, soft texture of Western pine is desirable.

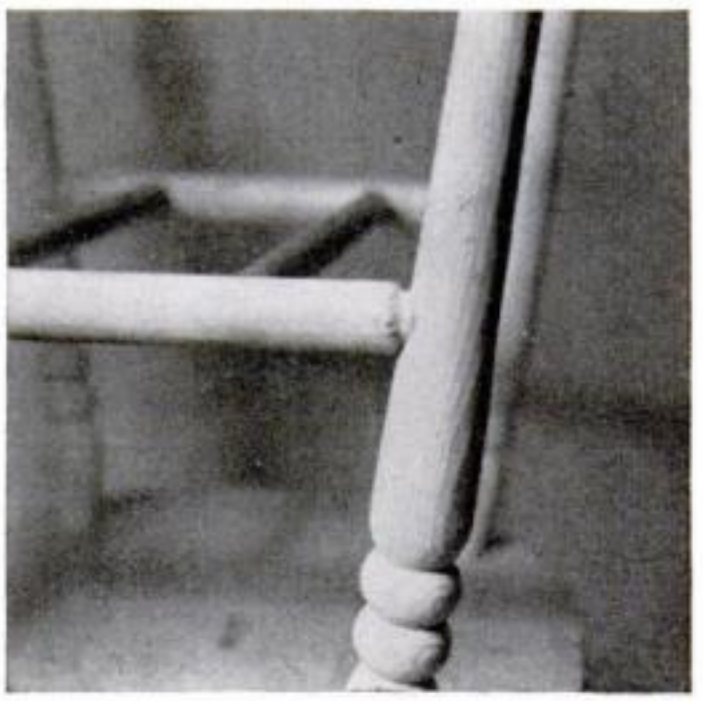
It is important to use the exact kind of painting materials needed if the finish is to turn out exactly as desired. There is no such thing as an "all-purpose" paint. Manufacturers make complete lines of paints, enamels, varnishes, dyes, and stains, and each maker's printed directions for his product should be strictly followed.

Don't mix old and new paints, nor paints of one manufacturer with paints of another, because the ingredients may be chemically unsuited. The make-up of finishing materials is changing because of new discoveries and shortages of such items as tung oil from China and lac from India. This doesn't mean that excellent finishes cannot now be had, but it does mean that there is grave danger in mixing old and new materials.

Four grades of sandpaper on a piece of wood. Left to right, they are Nos. 4, 2, 0, and 0000, No. 4 being the coarsest



Unpainted pieces seldom come sanded well at joints and the ends of rungs



Oak and other dyes are followed by a clear finish, rubbed with pumice and oil, and then waxed to a sheen

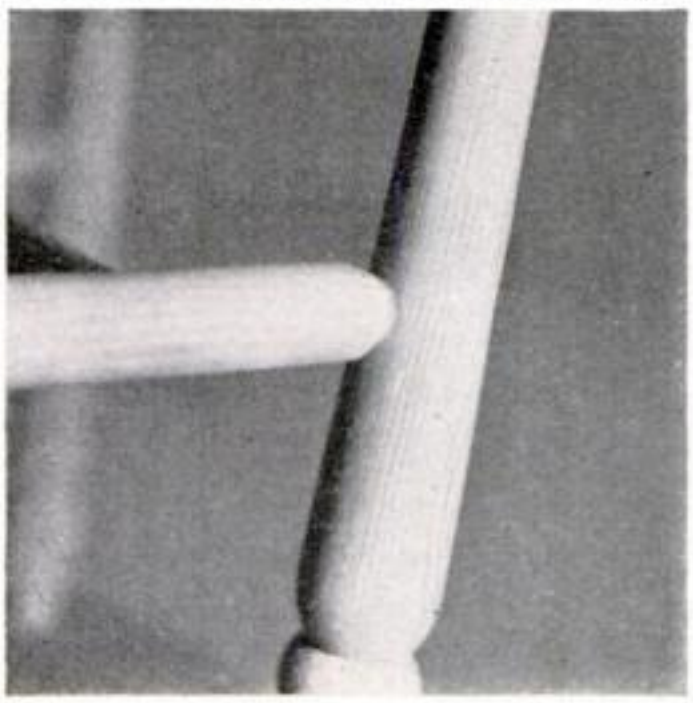
For furniture, use a soft varnish or enamel brush. To some extent these are also being made with substitutes. New Chinese hog bristles are scarce, yet fair brushes are available made partly of Chinese bristles, and others contain horsehair and Mexican istle, a vegetable fiber. A medium-quality brush will do a good job, but it will not last a long time. A cheap brush is a hazard at any time. Removing trailing hairs from a shedding brush can completely ruin a coat of quick-drying finish. Brushes should be preserved by thorough cleaning after use. They may be washed with warm water and soap, or a commercial brush cleaner may be used. Never stand a brush on its bristles when putting it away.

The proper conditioning of a piece to be finished is easily half the work of doing a good job. Any finish is only as good as the surface to which it is applied. Bare wood absorbs moisture, dirt, oil, and grease, and all these must be removed. The piece must be thoroughly dry all the way through. Moisture must not be painted in.

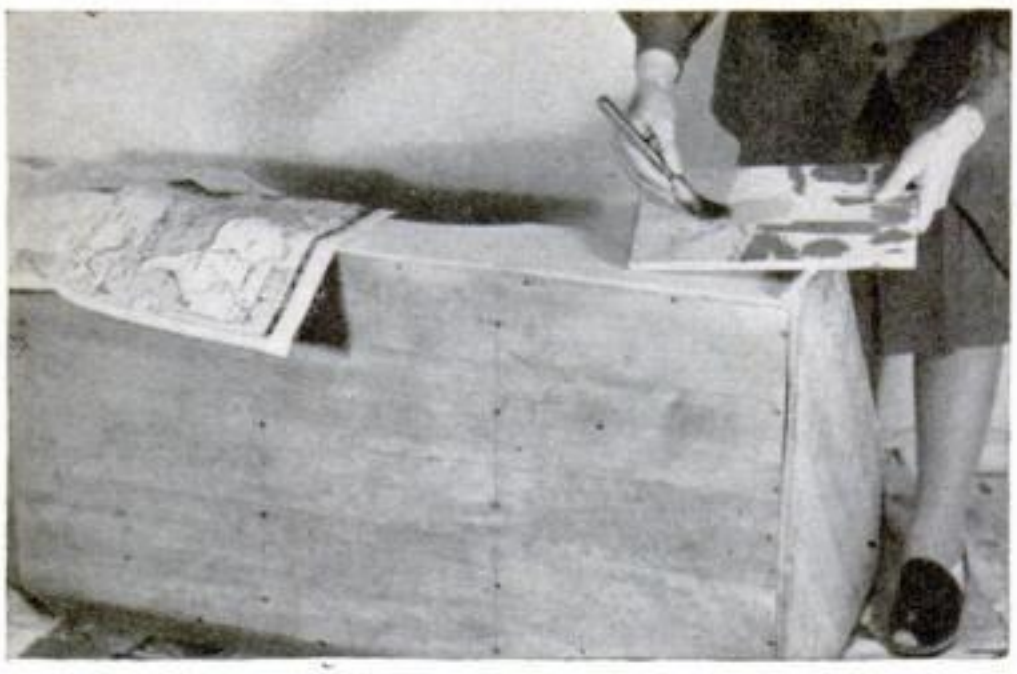
When clean and dry, the surface should be sanded to a pleasing smoothness with sandpaper wrapped around a block of wood having rounded edges. The final sanding should be done with the finest grit available, and if the sandpaper has been used before, so much the better. Keep your fingers off the surface so oil from the skin will not get into the pores of the wood. After sanding, dust the piece thoroughly with a clean brush or cloth.

Dust and dampness in the air are a hazard. Ventilate the room and put papers on the floor as a precaution against both raising dust and spilling paint. The time a coat of paint takes to dry varies with the weather, the type of paint, and even the ingredients in paints of the same type. As a general rule—and it is a safe one—double

A few light strokes of coarse and then fine sandpaper remove the rough edges



Smooth finishes depend upon smooth sanding. Use sandpaper on a block of wood, with even strokes following the grain



It is a safe plan to try colors on bare wood before they are applied to the piece to be finished. This allows changes if the shade is not just that desired

In general, the best method of painting stools, chairs, tables, and the like is to start with the piece turned upside down; then right it to finish the top surfaces

the time the directions give. Each coat must be dry all the way through, not just dry to the touch. Most first coats, and some intermediate coats, need sanding, so be sure each is thoroughly dry.

For pieces upon which brilliant, colorful coats are desired, such as outdoor furniture or small interior articles, there are quick-drying enamels that give satisfactory results in one or two coats. The larger indoor pieces, however, usually call for softer finishes that more or less show the grain of the wood. The general method of using these soft finishes is to treat the bare wood with a coat of white lead tinted with the color and rub it off before it dries; then follow with a coat of clear enamel and later with one or two coats of wax or varnish.

Enamels and paints are similar except for the final coat or two. An undercoat of flat or primer paint should precede the coats of enamel or paint. Enamel is flowed on with no more than one or two strokes of the brush. Paint, on the other hand, takes several strokes to spread properly. Enamels have hard surfaces and are best for pieces that get hard wear and washing.

Varnish is a transparent finish and may be clear or a varnish-stain, that is, varnish with a stain mixed directly with it. It is similar to enamel in that the latter is like an opaquely colored varnish, and, like enamel, varnish is applied with a soft brush and flowed on. Handsome finishes are obtained by rubbing between coats with fine wet-or-dry abrasive paper. Rubbing with rottenstone and oil at the very end will impart a high polish.

Oil stains have a wide appeal because both hard and soft woods take them and finish beautifully. Stir the oil stain well before and during use. Apply a medium coat thinned with turpentine, and let dry. One coat is usually enough, and a second should be applied only if necessary to deepen the shade. If the first coat appears too dark as it goes on, it can be rubbed off with burlap, excelsior, or crumpled newspapers. Varnish is applied as a finishing coat, or the piece can be waxed. A wood filler of

DO'S AND DONT'S FOR BETTER FINISHING

★

DO select the kind of wood for the kind of finish wanted.

DO prepare the surface of the piece thoroughly.

DO follow painting directions on the container through the entire procedure.

DO use paint made for the particular results desired.

DO sand between coats for a professionally smooth surface.

DO clean, wash, and store brushes properly for future use.

★

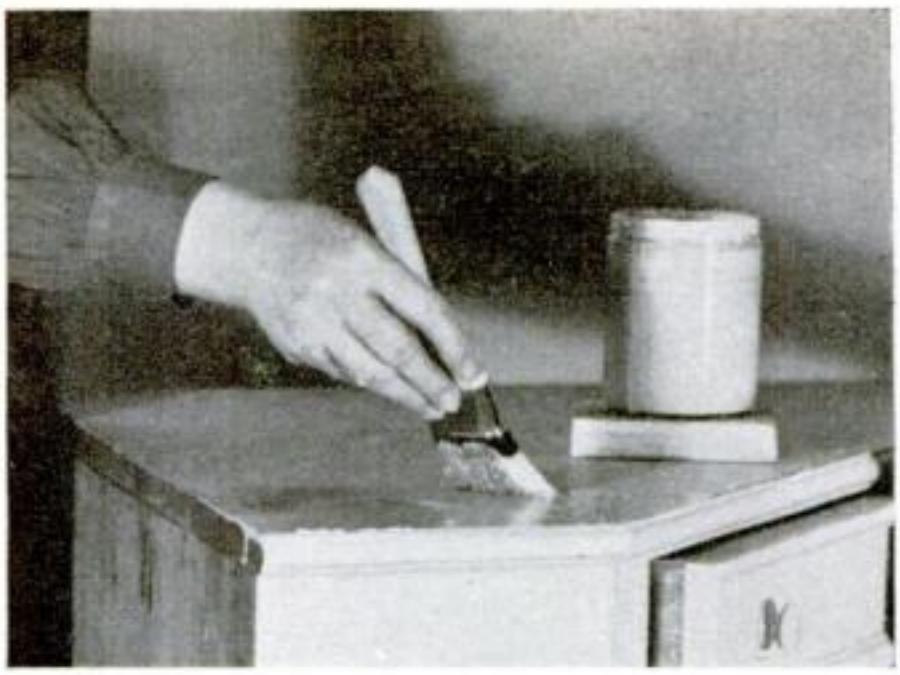
DON'T paint damp wood or paint in a damp atmosphere.

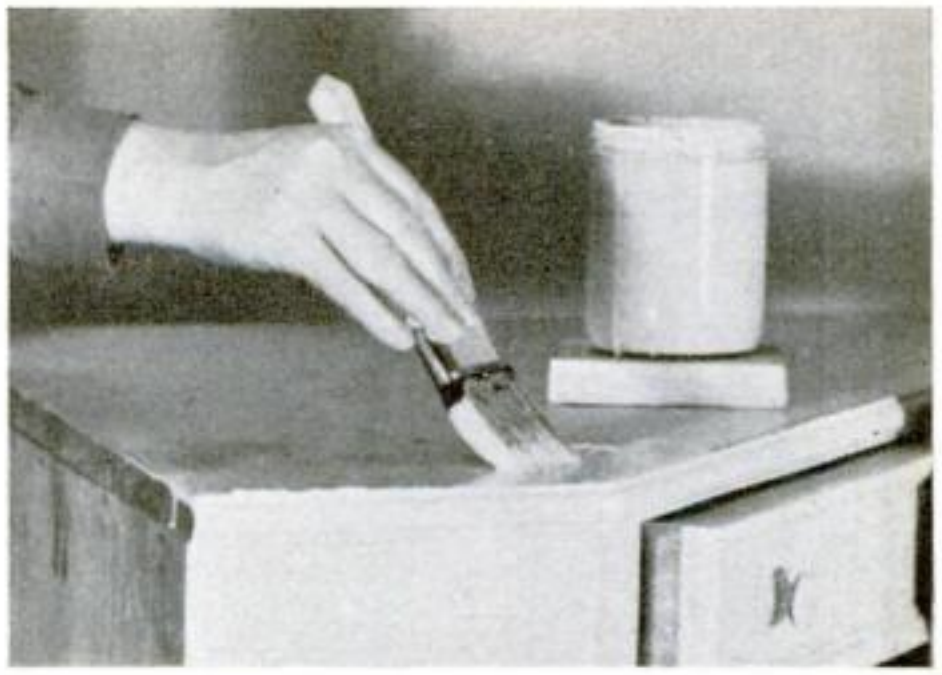
DON'T use the wrong kind of brush for the job.

DON'T buy cheap paint and expect good results.

DON'T paint over a coat that hasn't dried through thoroughly.

DON'T paint in a dusty atmosphere.

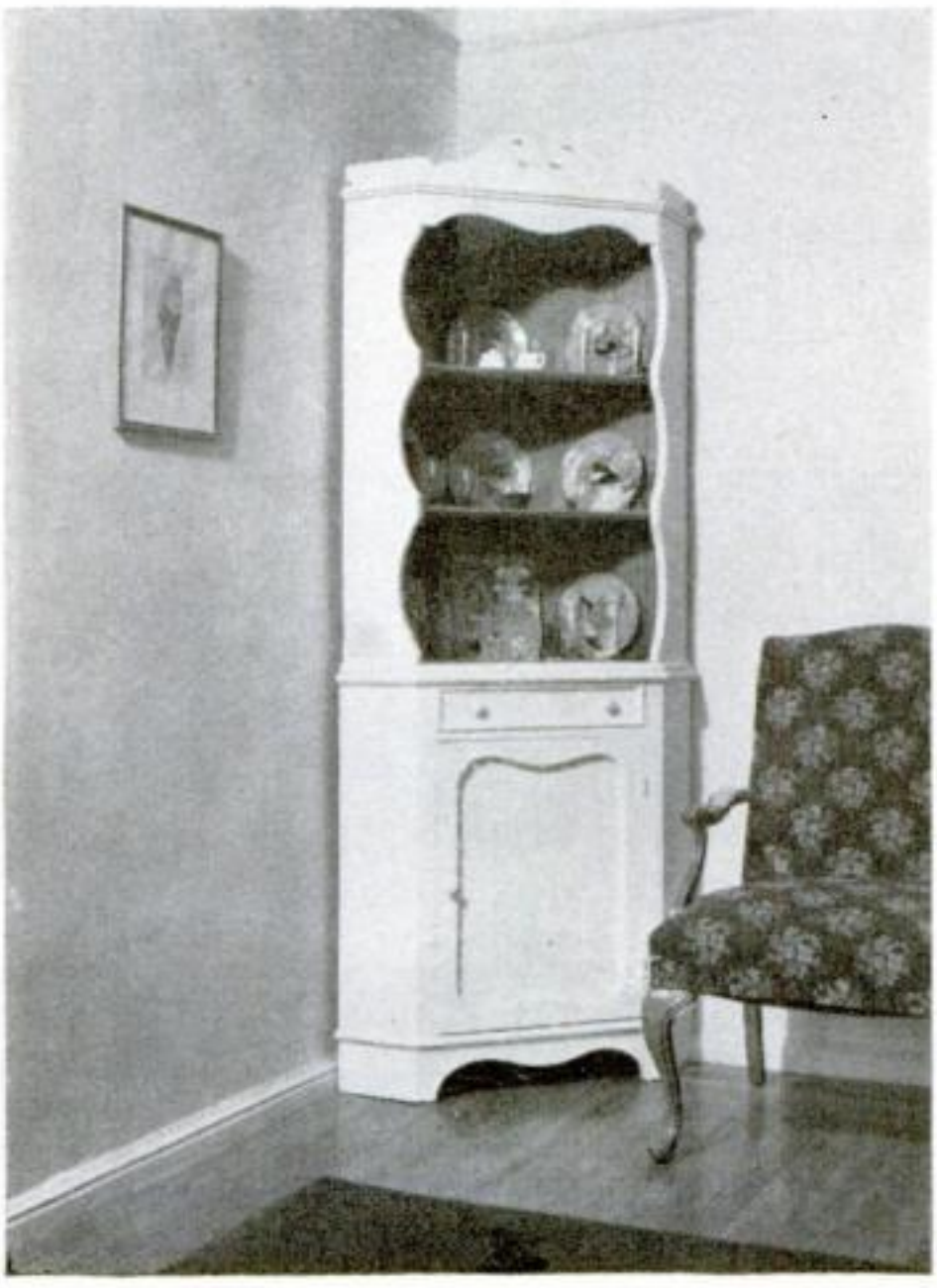




Hold the paintbrush lightly but firmly with the handle extending between the thumb and forefinger; then, regardless of the direction of the stroke, the brush will always be under complete control

the proper shade is used before this final varnishing or waxing if the grain of the wood is extremely open.

Dye coats offer a wide choice of finishes ranging all the way from platinum through sandalwood to walnut and mahogany. Both close-grained and open-grained woods are suitable for dye finishes. First, apply a dye coat sparingly with a brush and let it dry 24 hours. Then apply a clear finish made by the same dye manufacturer and, after another 24 hours of drying, sand lightly. Finish with another coat of clear, and buff with wax after it is dry. Varnish or clear shellac may be used for this third coat.



This cream corner cupboard is a trifle lighter than the wall. Its blue interior was softened by rubbing with thinned white and a trace of pumice

Antiquing furniture surfaces of light color takes off the effect of newness, yet at the same time preserves the protective coating. The process is simple. Squeeze a little oil color, preferably burnt umber, raw sienna, or Vandyke brown, in a cup and thin it with ⅔ turpentine and ⅓ linseed oil. Rub this mixture on the piece and off again, using a wad of cheesecloth. Leave darkened places in the corners and little or no color on the flat surfaces.

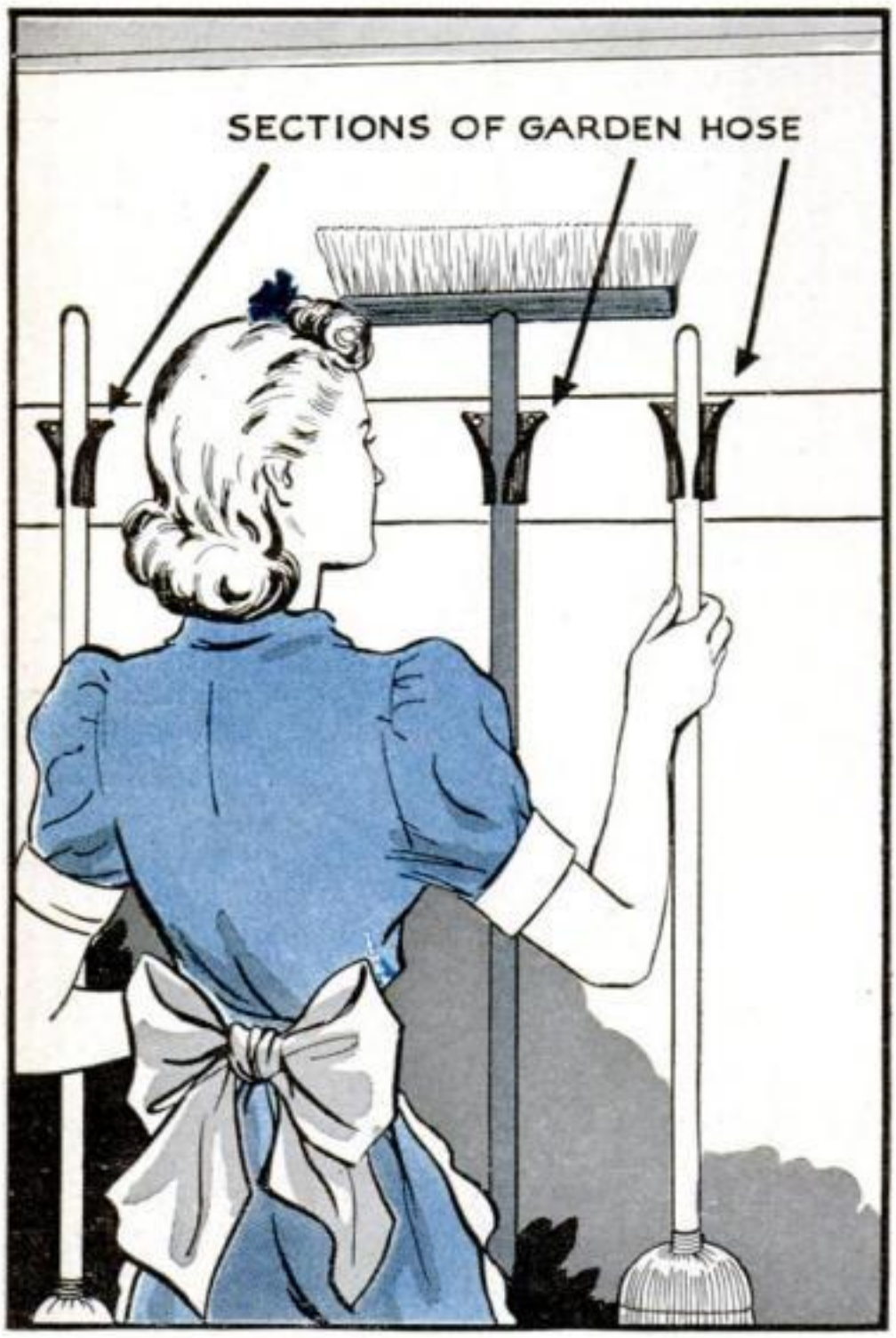
A pumpkin-brown finish is obtained by rubbing on and off a coat of boiled linseed oil colored with burnt sienna and a bit of ultramarine blue. After drying, sand lightly, apply a clear coat, and follow with wax. These colors are transparent pigments and allow the wood to show through.

Driftwood-finished effects are made by first applying a thin base coat of dye of this particular color. Use a fine brush. Follow this with a thin coat of clear finish and sand it lightly when dry. A second coat of clear finish completes the job.

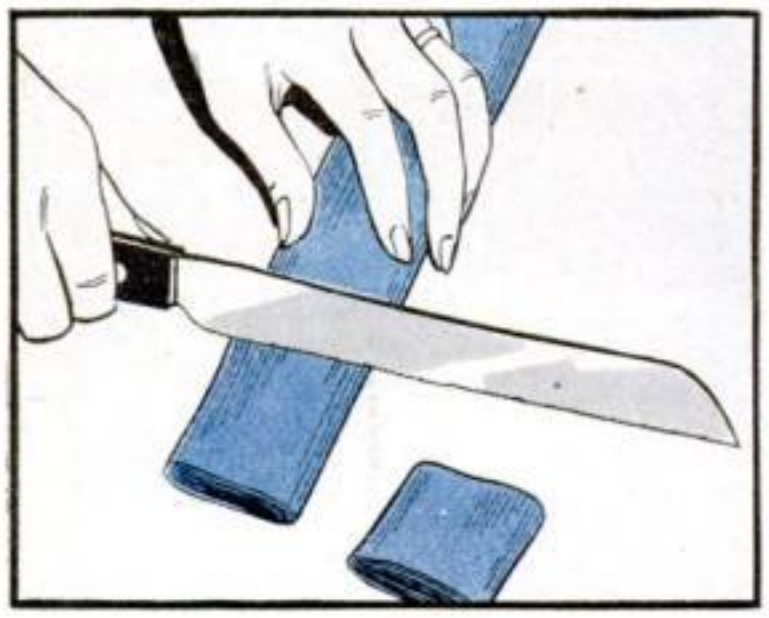
Light walnut can be put on fine-grain woods by mixing burnt umber, lampblack, and rose lake, which has a slightly reddish cast, or rose pink, which is a little browner, in boiled linseed oil thinned with a little turpentine. Try the mixture on a piece of wood first to make sure the color is right. After drying, finish with a clear coat and wax.

Blond finishes are obtained with a white undercoater paint tinted with raw sienna and raw umber and thinned with turpentine and boiled linseed oil. Rub this across the grain and let it set until it gets sticky; then rub it off. When the surface is thoroughly dry, apply a coat of clear finish, white shellac, or varnish, and then wax.

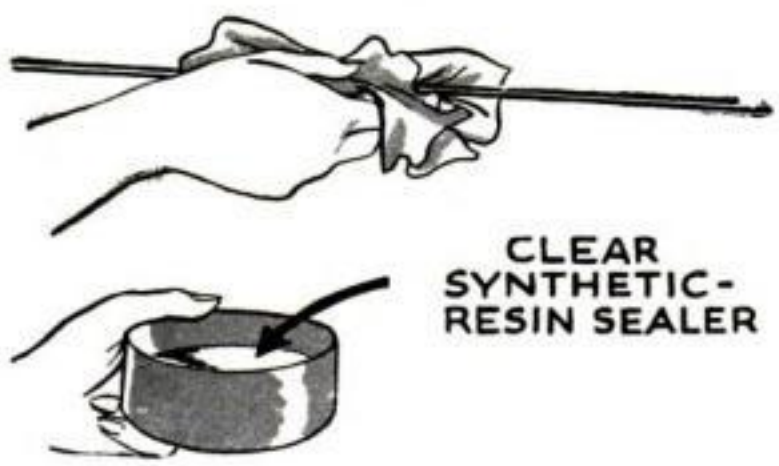
KEEPING



Perhaps the extra strain from trying to keep your Victory garden well watered this summer has put your old hose on the scrap pile. Before turning it over to the salvage collector, you might cut off three or four 3" sections. These will make handy holders for brooms, mops, and the like in your hall closet. Split them lengthwise and nail to the closet wall. Just a moderate downward pressure on the handles is sufficient to make the holders grip firmly



Crepe-paper rolls that are to be cut into strips often are too bulky to be easily cut with scissors. A bread knife with a serrated cutting edge will do the job more quickly and leave as neat an edge



Wire clotheslines can be protected against rust with a sealer such as is used for new woodwork. Remove any excess before it hardens, leaving a thin film. This will also make lines easier to clean and keep clean

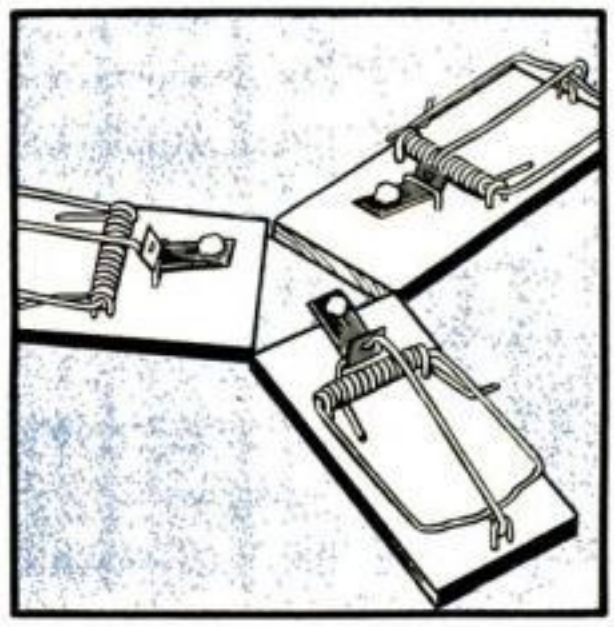
The rough bottom of a vase can be smoothed by rubbing it over fine sandpaper. In severe cases, wet the bottom with turpentine first

Dress up a drab-looking flowerpot by covering it with a lamp shade. Shades that fit are easily found, since they are made in many sizes

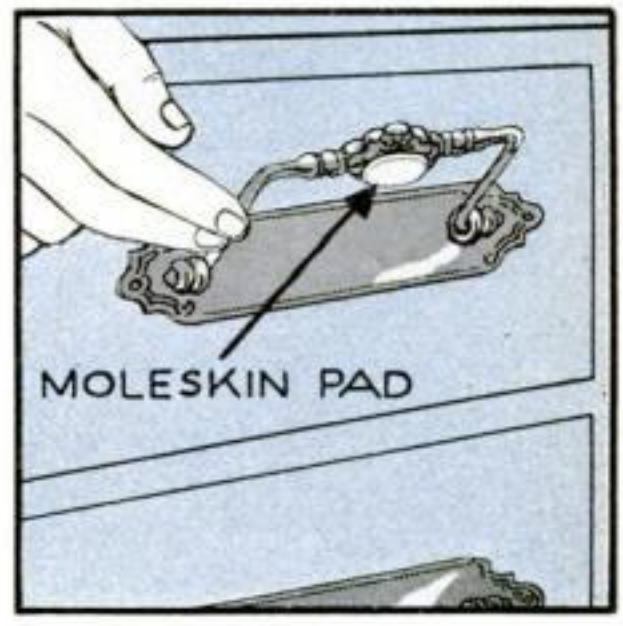
To remove the lid from a jelly glass without damaging the top, place half a spring clothespin between it and the can opener

THE HOME SHIPSHAPE

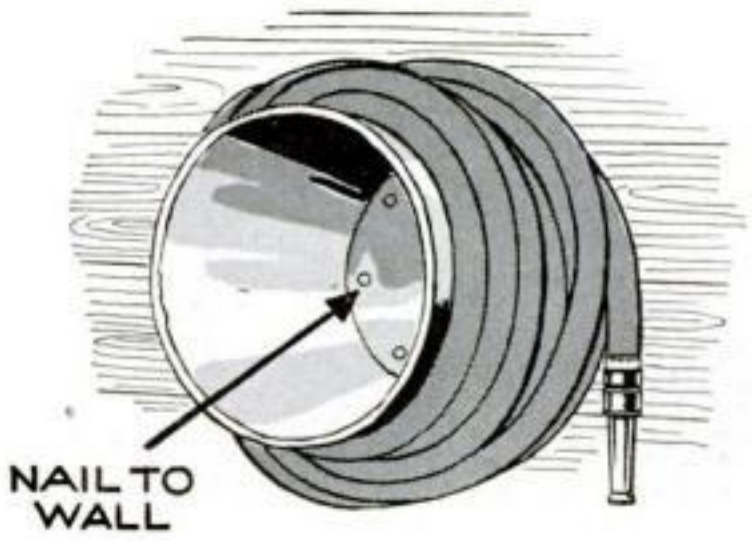
Mucilage kept in a small oil can will spread more evenly and more neatly on the backs of clippings you are pasting in your scrapbook. Apply along the four edges only



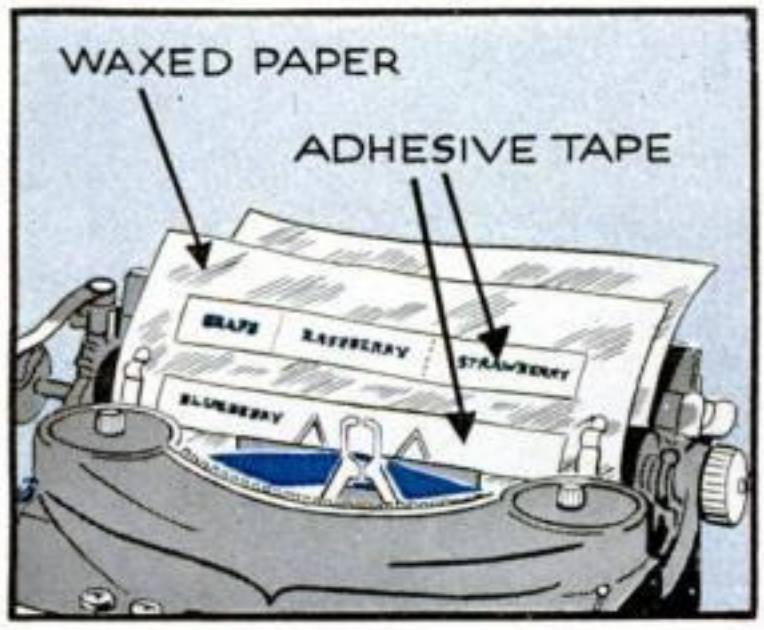
Mice or rats who eat the bait left for them in the trap, and then go off instead of being caught, will back themselves into trouble if you set three traps in this manner



When swinging drawer handles mar furniture, pad the underside with the adhesive moleskin that is sold for padding shoes. Use it also on lamp bases to prevent scratching

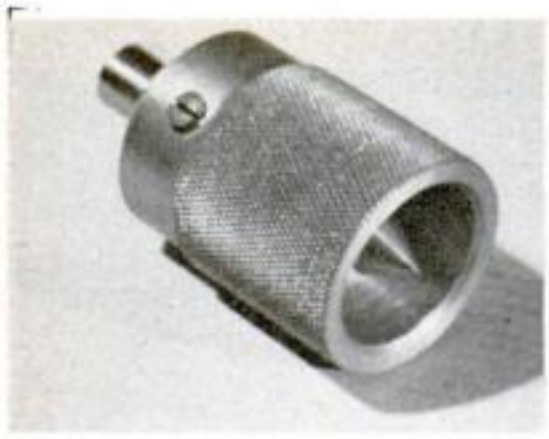


Here's how to keep the kinks out of your garden hose so that it won't wind up as rubber salvage. Simply nail an old water pail to the side of the house or garage and wrap the hose around the pail as shown

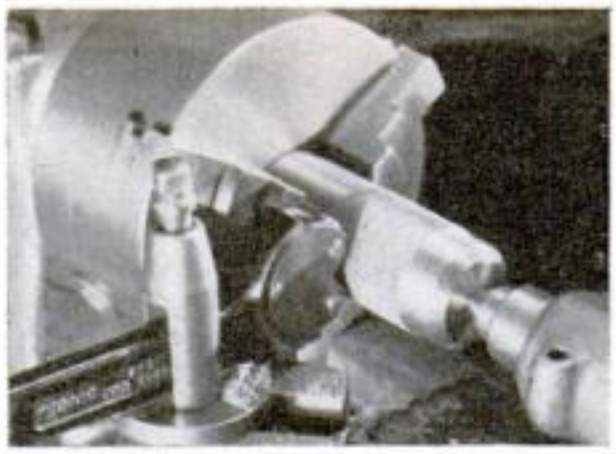


Adhesive tape can be used for durable typed labels if it is stuck on wax paper before insertion in the machine. It readily sticks to other surfaces after it is pulled off

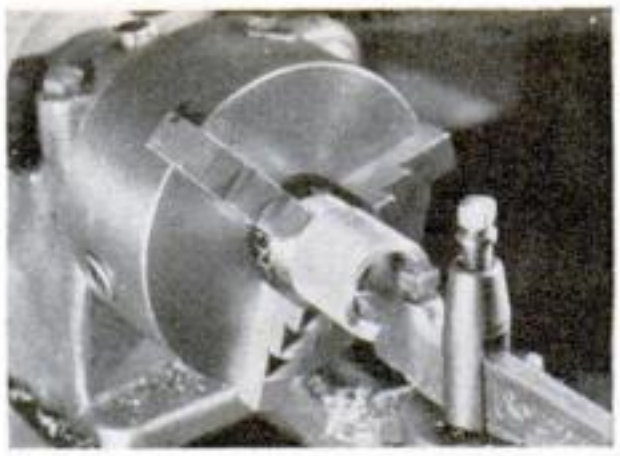
You can make an extra closet shelf by using a piece of board long enough to stretch between the existing shelf and a cleat on the opposite wall. Two Z-shaped strap-iron brackets fastened to the board rest atop the old shelf



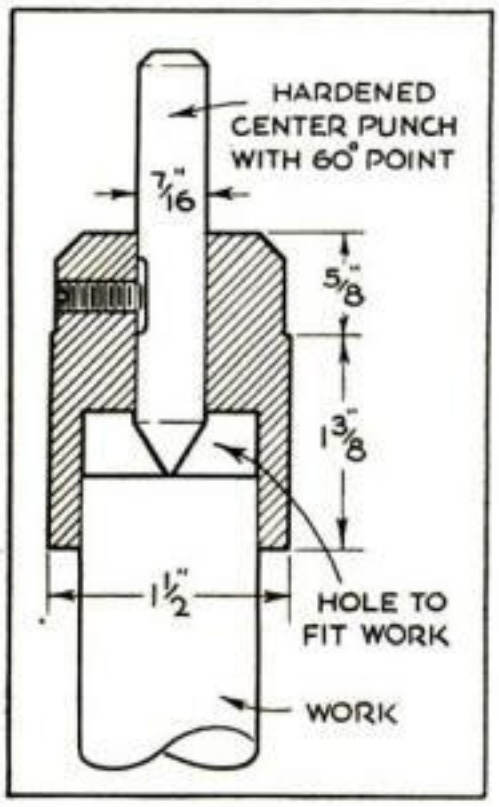
This useful cup center punch saves time in the small shop



Chuck a piece of steel, centerdrill, and turn to dimensions



Reverse the piece, counterbore for stock size, and knurl grip

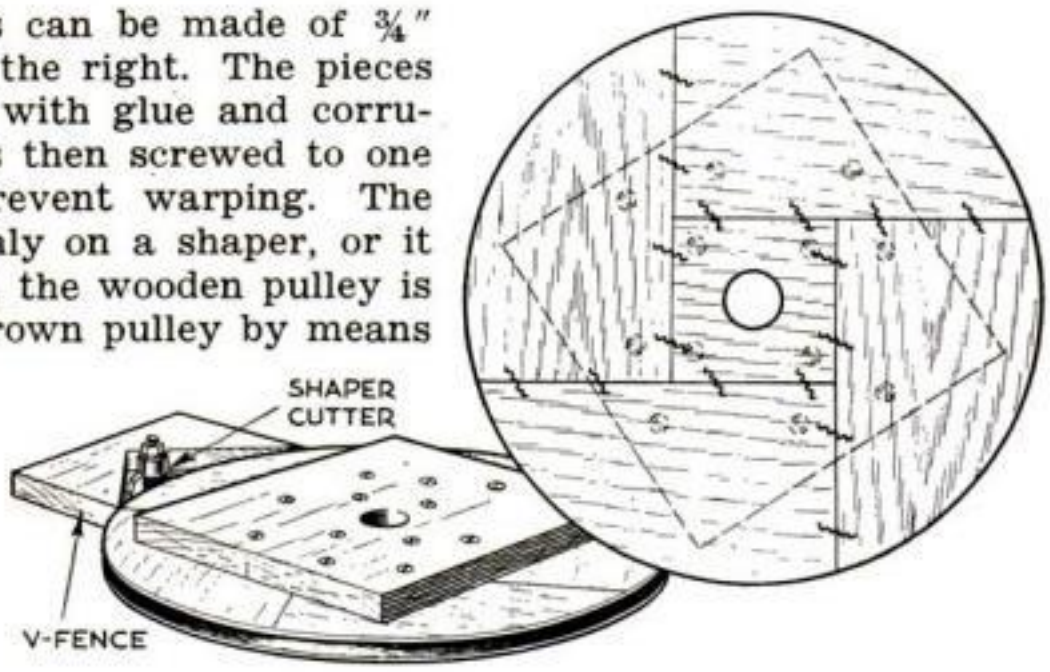


A CUP CENTER PUNCH, shown in the photo at left above, is a timesaver in locating center holes, especially in the small shop with a quantity of round bar stock to center. It differs from the bell-type center punch in that it is made for one size stock only and, when it is slipped over the end of the work, is held rigidly in line with the bar. When the punch is tapped with a hammer, the center is located quickly and accurately.

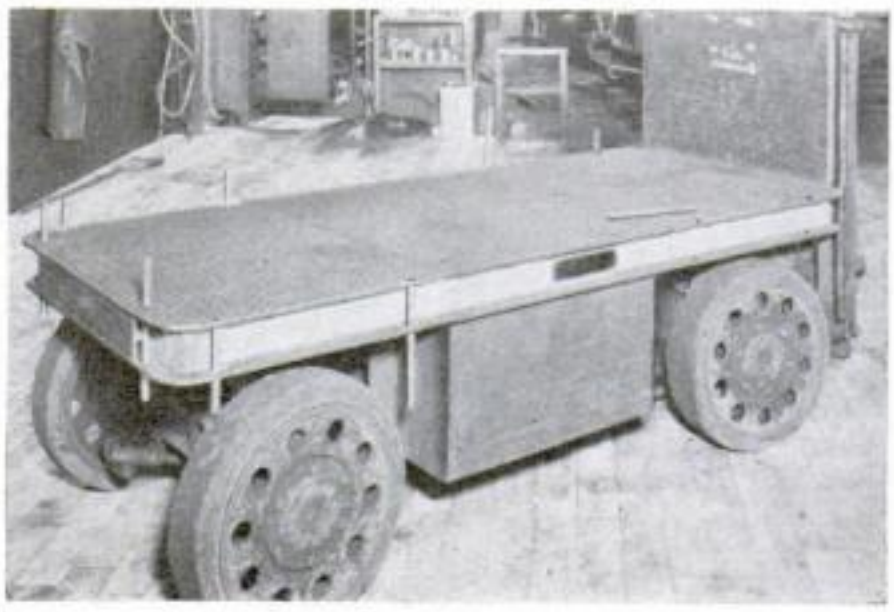
In making up the body of the punch, a piece of steel is chucked, centerdrilled for tailstock support, turned to the dimensions given on the drawing, knurled for a good finger grip, and cut off. With the piece reversed in the chuck, the center-punch hole is drilled and the end counterbored to fit the stock. A hole is drilled and tapped in the body for a set-screw, which projects into a flat filed on the punch and keeps it from falling out but allows it a limited movement. The punch is turned to a blunt point at one end and slightly beveled at the other. It is then hardened, tempered, and ground to a 60-deg. point.—C. W. WOODSON.

LARGE WOODEN PULLEYS for V-belts can be made of ¾" thick wood as shown in the drawing at the right. The pieces are cut to shape and fastened together with glue and corrugated fasteners. A large square piece is then screwed to one side for additional strength and to prevent warping. The groove can be made quickly and smoothly on a shaper, or it may be cut with a chisel. When finished, the wooden pulley is attached to the side of the flywheel or crown pulley by means of U-bolts or heavy wire.

A single big pulley such as this will give the necessary speed reduction for operating a concrete mixer, corn sheller, cream separator, fanning mill, or other such equipment from a ¼-hp. electric motor.—R. E.



ADJUSTABLE PINS in the edges of factory trucks at the General Electric plant in Schenectady, N. Y., replace blocks once used to keep such articles as studs, pipes, and boxes from sliding off. Six ¾" steel pins set in holes drilled in the platform of the truck, two on each side and two at the open end, can be adjusted with cotter pins from a position flush with the deck of the truck to one 3" above it. In the raised position, the pins not only keep the load on the platform but facilitate tying it with rope when this is necessary.



USING THE MODERN SHAPER

How a Steel V-Block Is Machined on This Versatile Power Tool

MACHINING a rectangular slot or a V-groove in a short piece of metal is a job that might well be done on a shaper, which is a small planing machine with a short, forward cutting stroke. The piece is fastened to a table that holds it stationary as the tool takes its cut. This table can be adjusted to any convenient height, and it has a cross feed, operated both by hand and power, for use when a finished cut is to be wider than the tool. Depth of cut is regulated by vertical movement of the tool head.

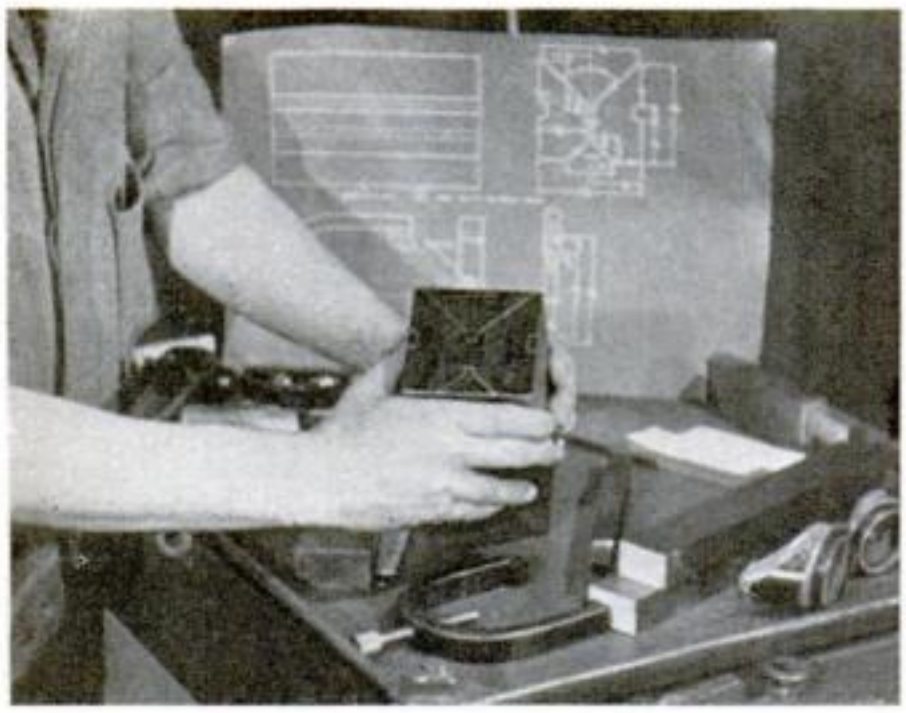
A crank mechanism changes circular motion to reciprocating motion, and is so designed that the return stroke is faster than that for cutting, thus reducing the time on a job. The tool head has a clapper action on the return stroke, making withdrawal of feed between cuts unnecessary.

Work may be clamped to the table, held in a vise, clamped to an angle plate, or held between index centers. Often the piece is rested on cast-iron or steel parallels.

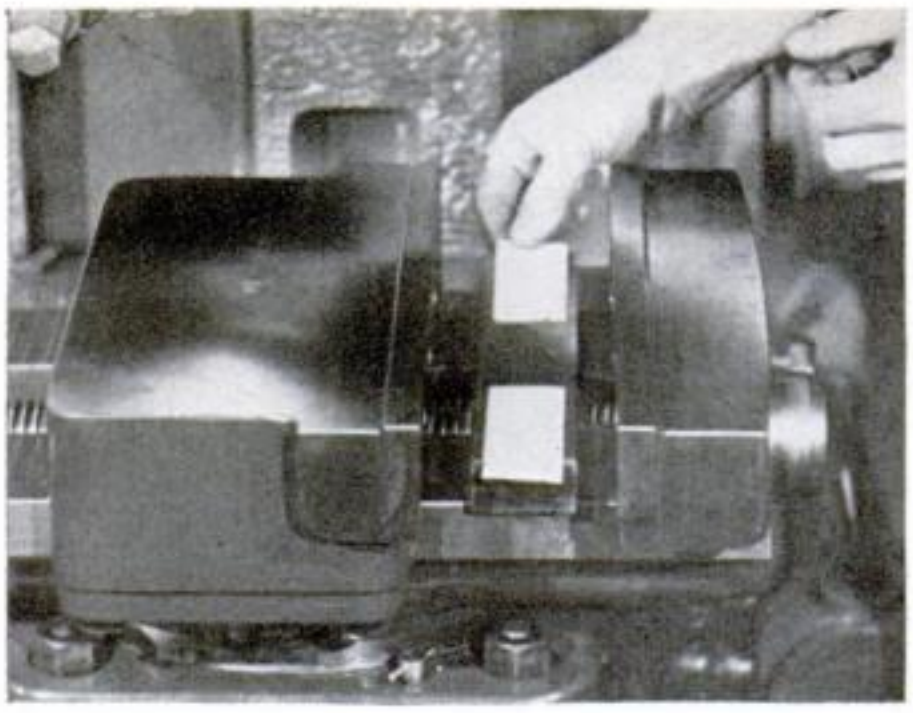
Tools, though smaller, have the same shapes and clearance angles as those for planers, and are described in any good machinist's handbook. They may be made to cut at an angle by swinging the post and head on a swivel and setting to a scale marked in degrees. Special tool holders are available for mounting interchangeable bits ground for other cutting operations.

Be sure any tool is tight in the tool post and that the work is neither loose nor too high—otherwise you run a risk of damaging or wrecking the machine. Always wear goggles and keep your hands away from the work while the machine is in operation.

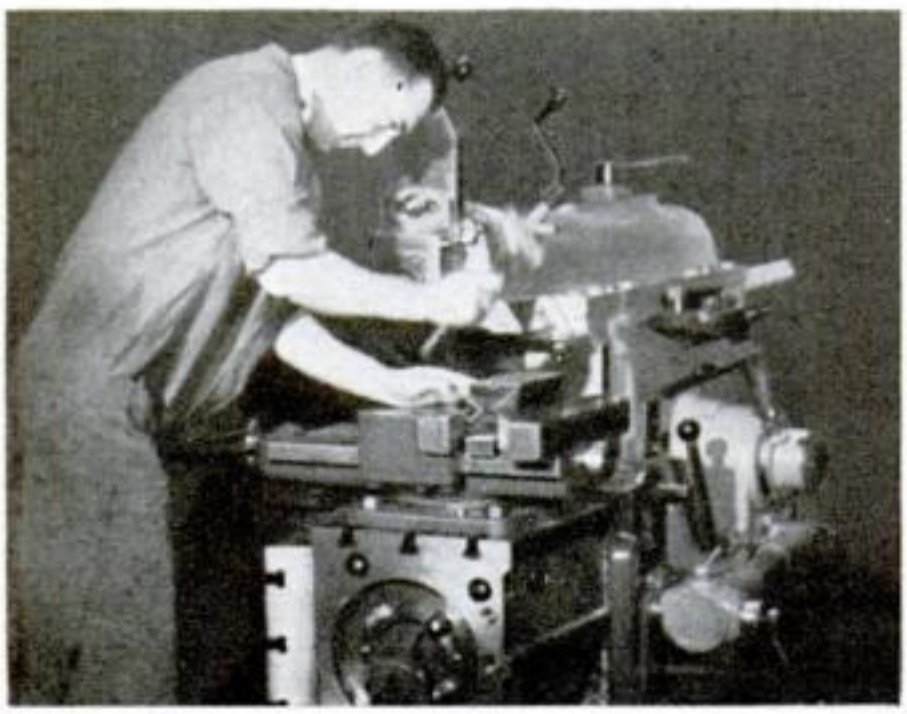
One of the motion pictures produced by the U. S. Office of Education for training machine-tool operators, and distributed for the Government by Castle Films, deals with shaper operations for machining two rectangular slots and two V-slots in a piece of tool steel 6⅞" long and 3" square. Operations from the film are shown in the photos on the following pages.



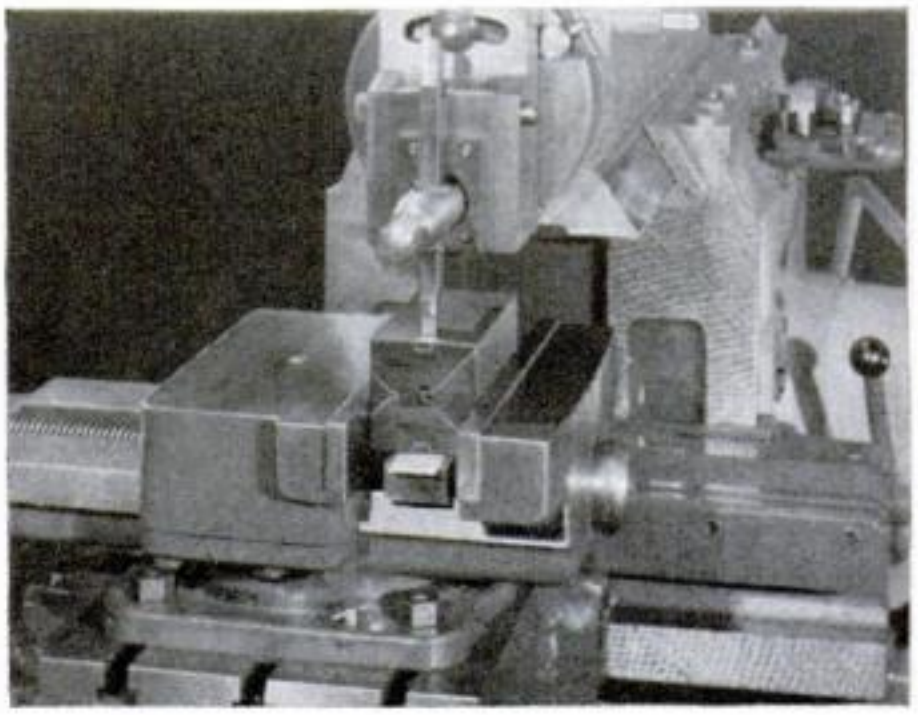
1 Two rectangular slots and two V-grooves are to be cut in this block of tool steel. The ends are painted with Prussian blue, and the layout is made according to the plan as a guide for cutting



2 After the shaper is carefully brushed, papers are laid at each end of the parallel to serve as indicators that the work is down tight. If it is, the papers can't be pulled out after clamping



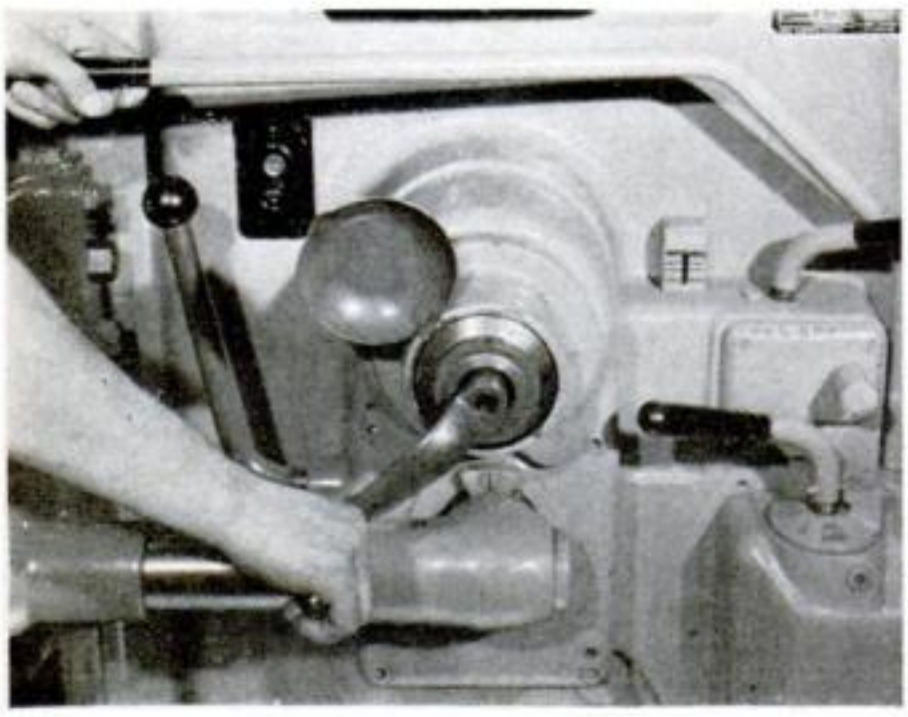
3 When the vise has been tightened snugly, the block is driven down on the parallel with a soft hammer; then the vise is tightened further. If a paper pulls out, the work must be reclamped

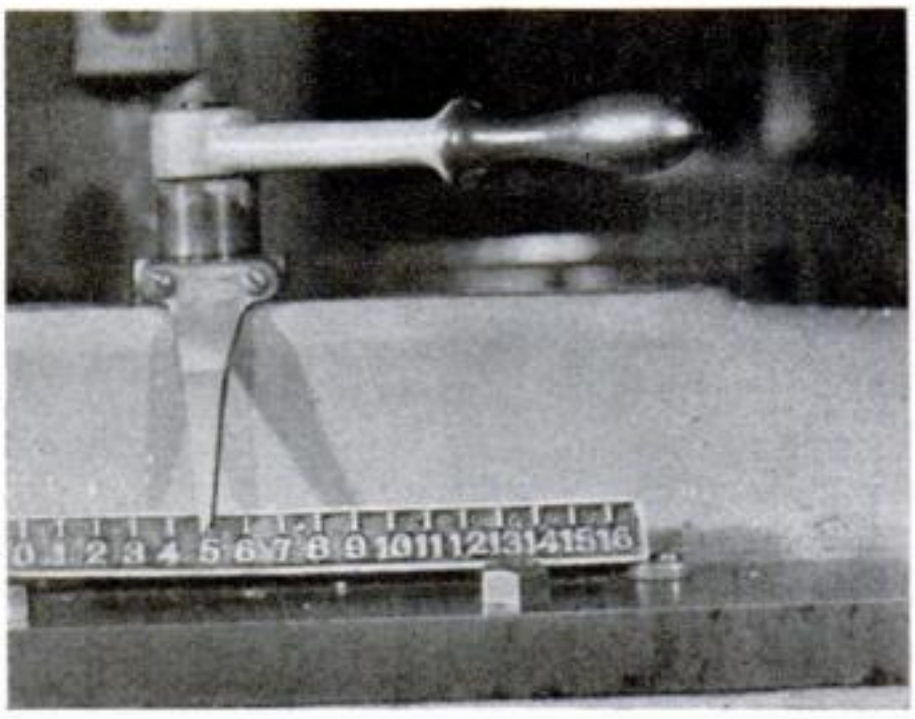


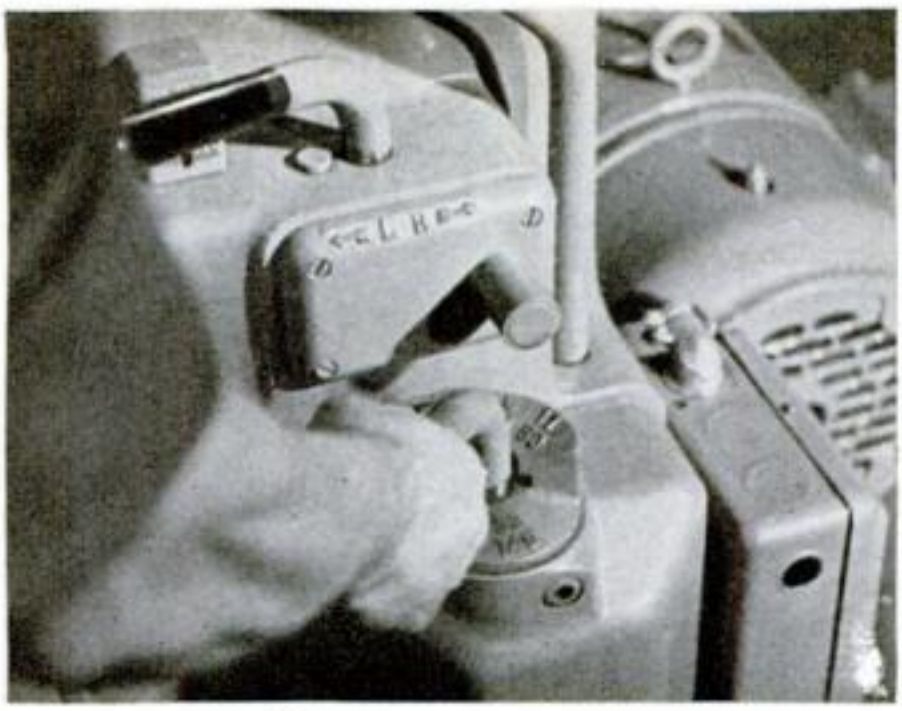
4 To avoid clamping difficulty when the block is turned, the rectangular slots are machined first. A square-face tool is ground to the width the slots are to be and is clamped in the tool post

5 After the tool is leveled on the block, the length of the ram stroke is set. For a block 6⅞" long, an 8" stroke will allow 1⅛" at the end for tool clearance and downward feeding

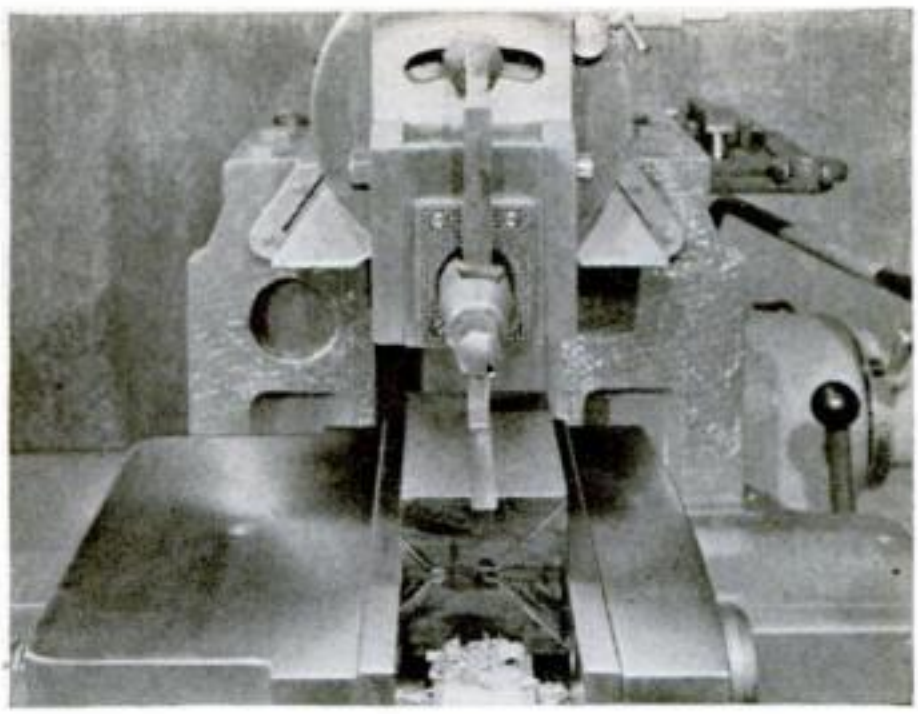
6 On some shapers, the stroke is controlled by an adjustment screw, as in the photo at left. Others have a scale on the ram, as below. Both principles are the same. Readings are in inches



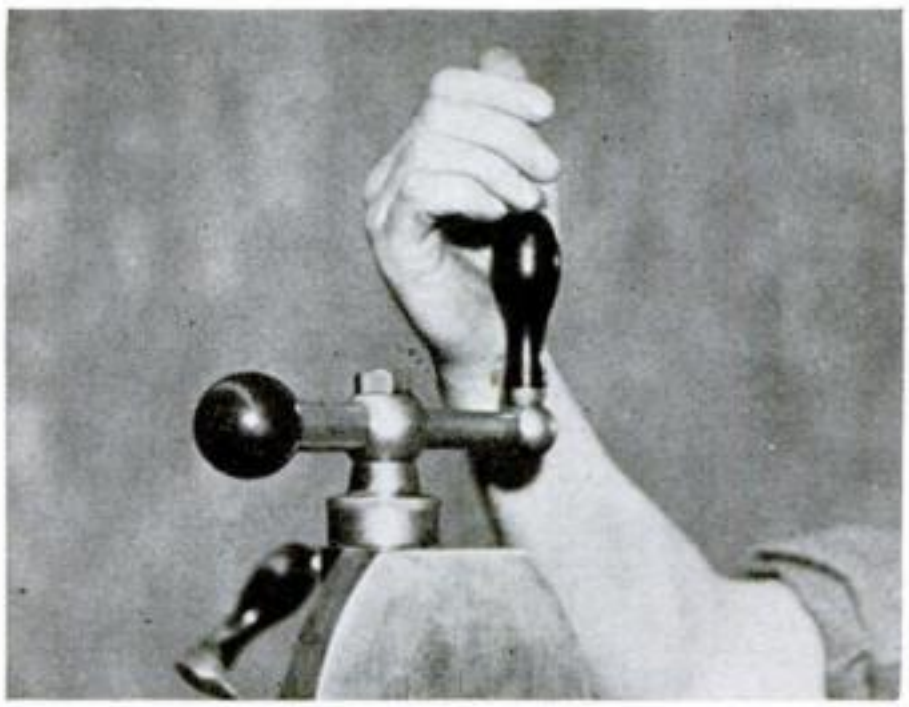




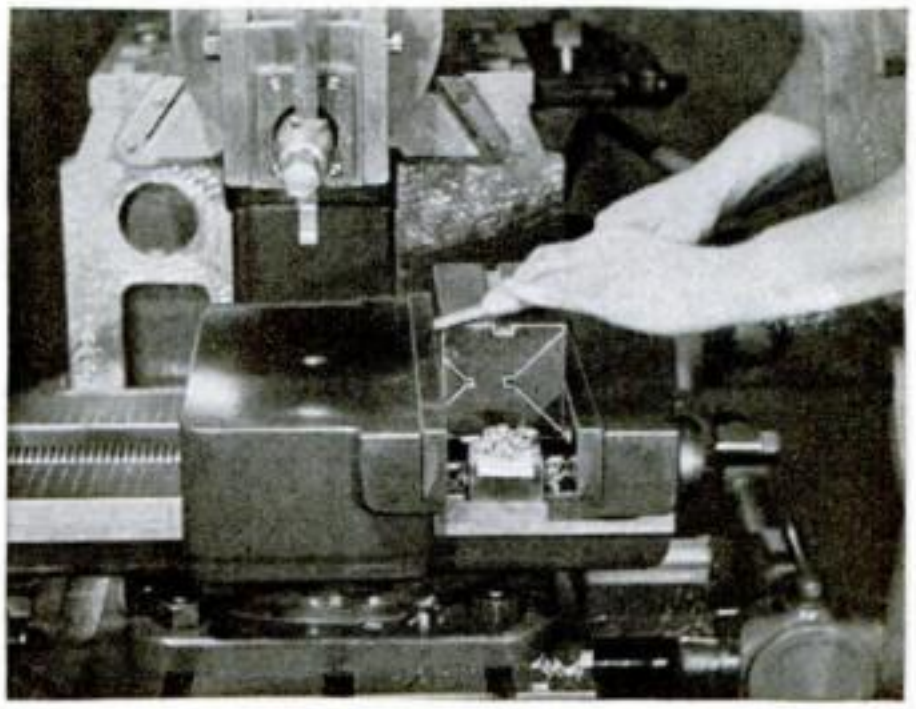
7 Once the ram stroke is set, the speed of the ram and tool must be determined. Reference to a handbook shows tool steel can be cut at 11" per minute, so the gears are set for that speed



8 Now the cutting action begins. With the tool placed over the layout, it is fed down .002" on each stroke. A tool as wide as the slot is used, since extreme accuracy is not required here



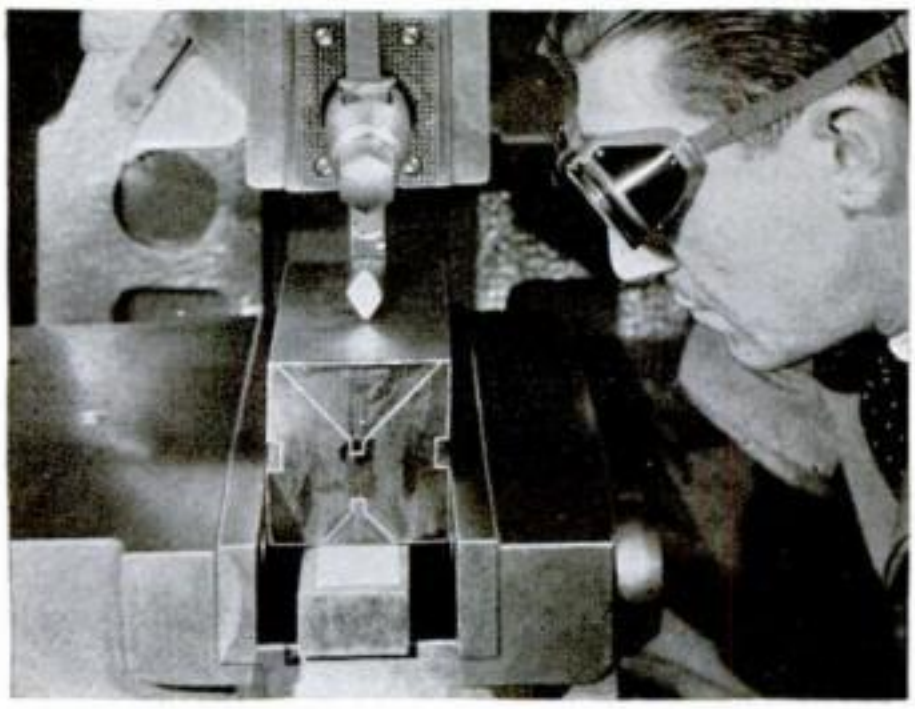
9 At the end of each return stroke, the tool head is fed down by hand. This can be done by tapping the feed screw handle with the heel of the hand. Practice soon makes feeding uniform

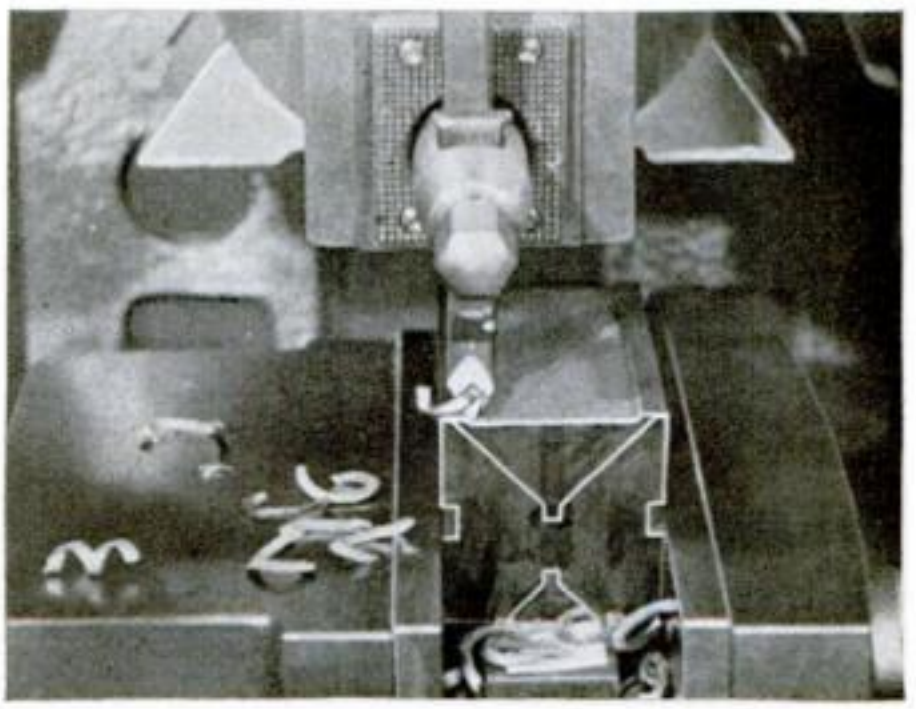


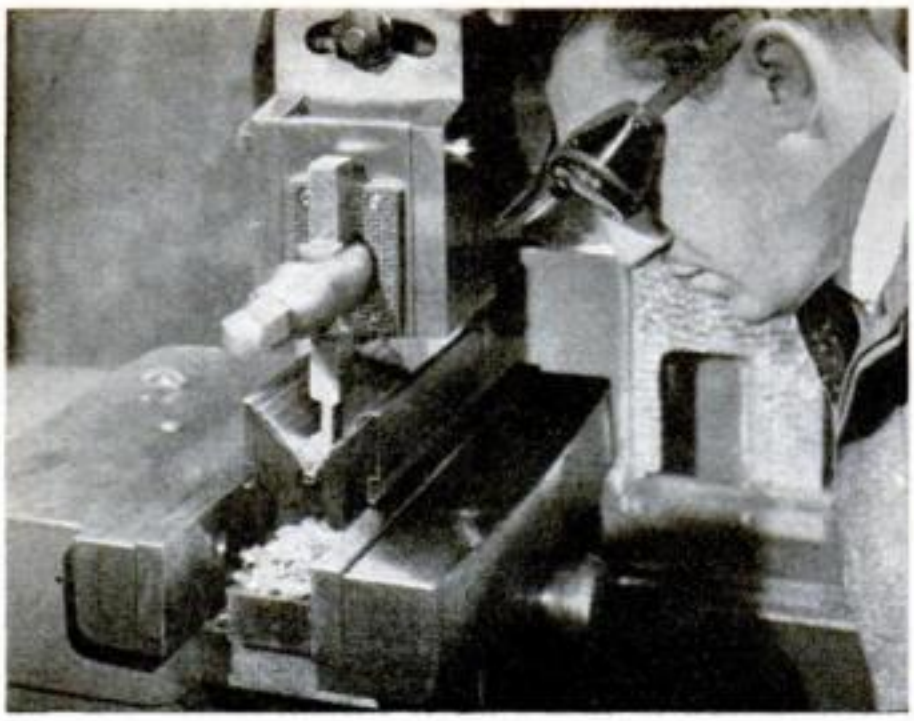
10 When the slot has been cut to the proper depth, burrs are removed by filing. The work is then turned over, and the opposite side is machined by following just the same procedure

11 With the rectangular slots cut, the block is leveled and clamped for machining the large V-slot. Mark the vise and clamp the block under the same ram stroke. A diamond-face tool is used

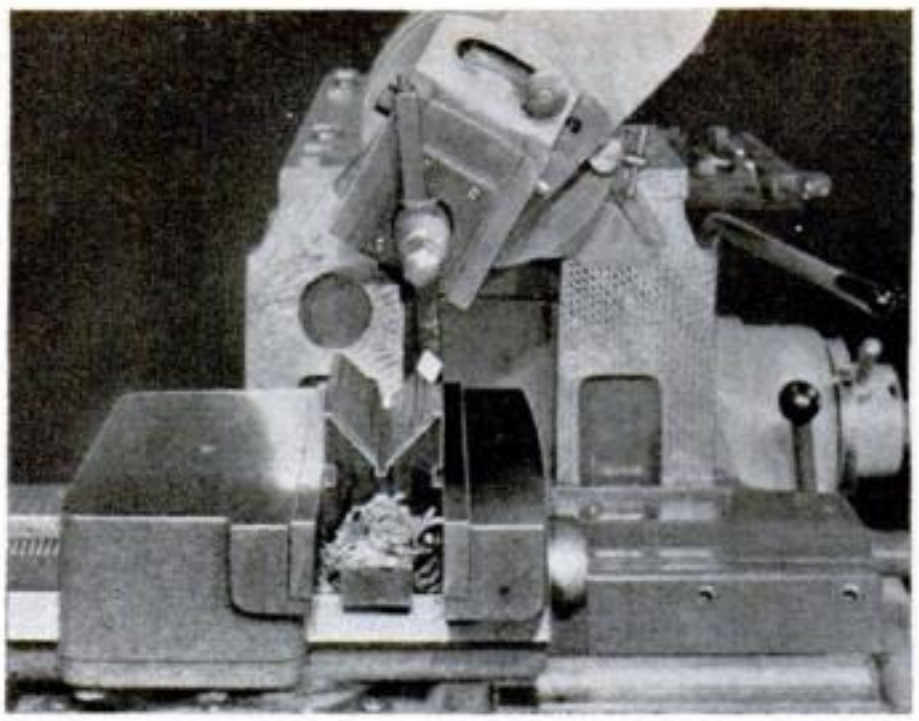
12 Make .100" roughing cuts with the power cross feed set at .080" per stroke. This feed is reversed within safe margins. The tool is fed down by hand between runs [CONTINUED]



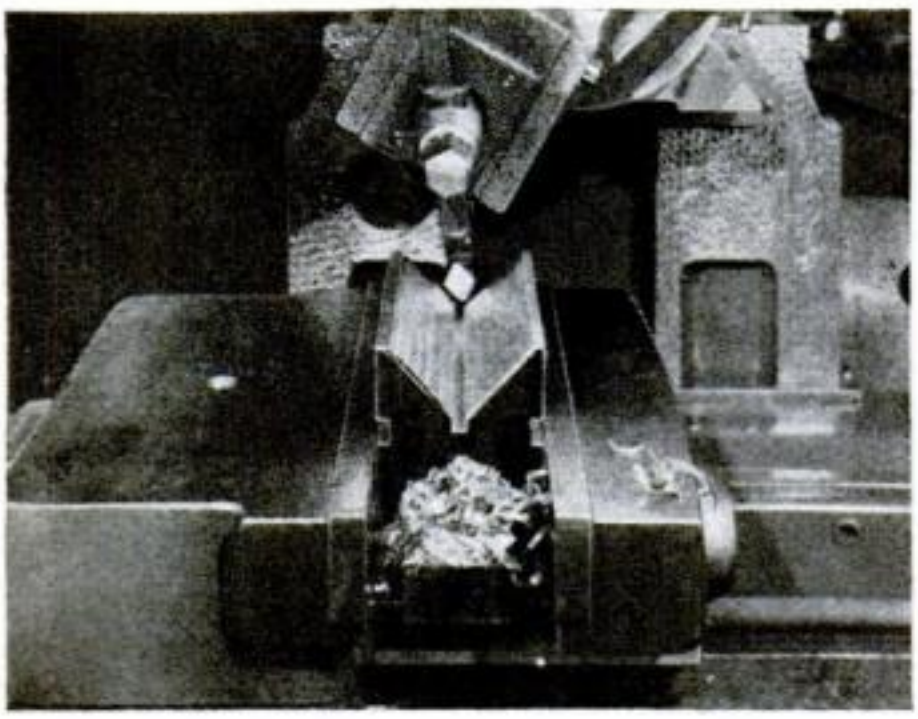




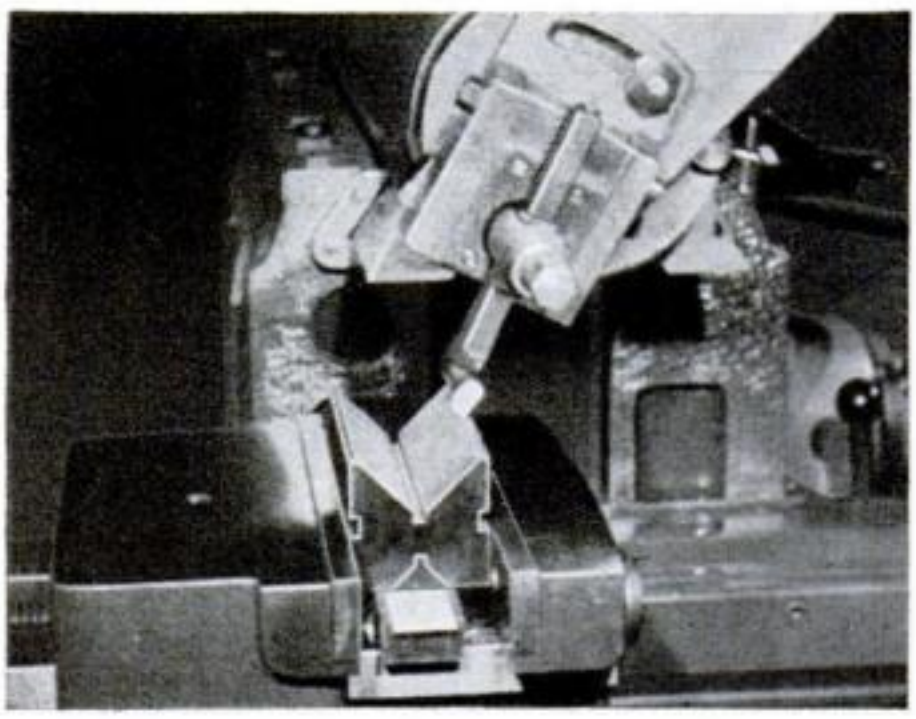
13 Near the bottom of the *V*, the power drive is shut off, and cross-feeding is finished by hand. The rectangular slot is next cut in the bottom with a square tool ground to full width



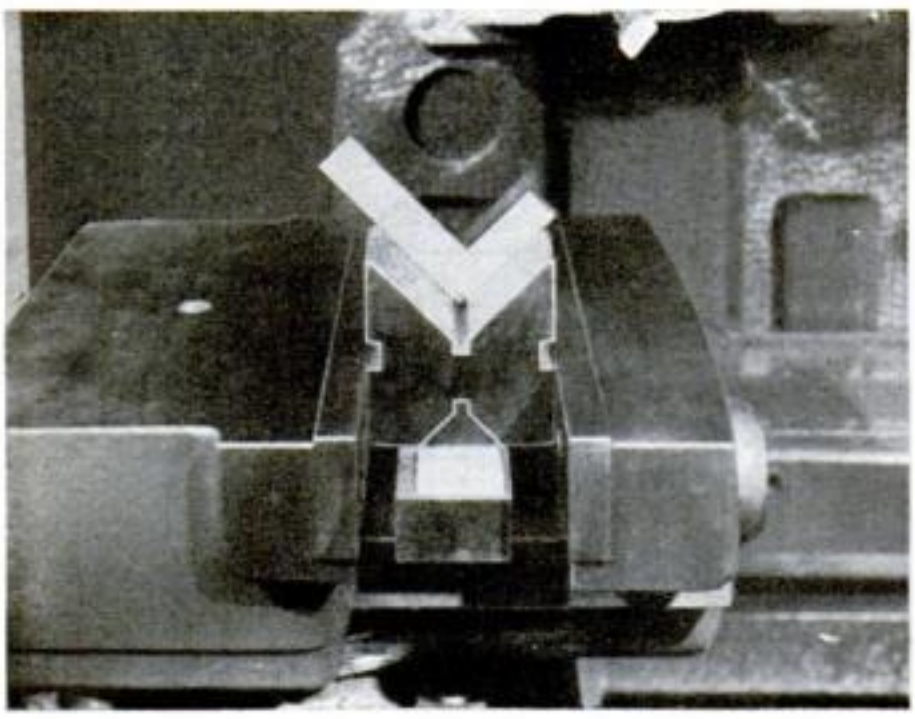
14 For finishing the sides, the tool head is set at 45 deg., and a roughing tool is set vertically in the tool post. Hand feeding will move the tool down the 45-deg. slope of the slot



15 This preliminary finishing cut should leave .010" for a final cut. The tool and head both remain in position, the vise is marked, and the work is turned for machining the second face



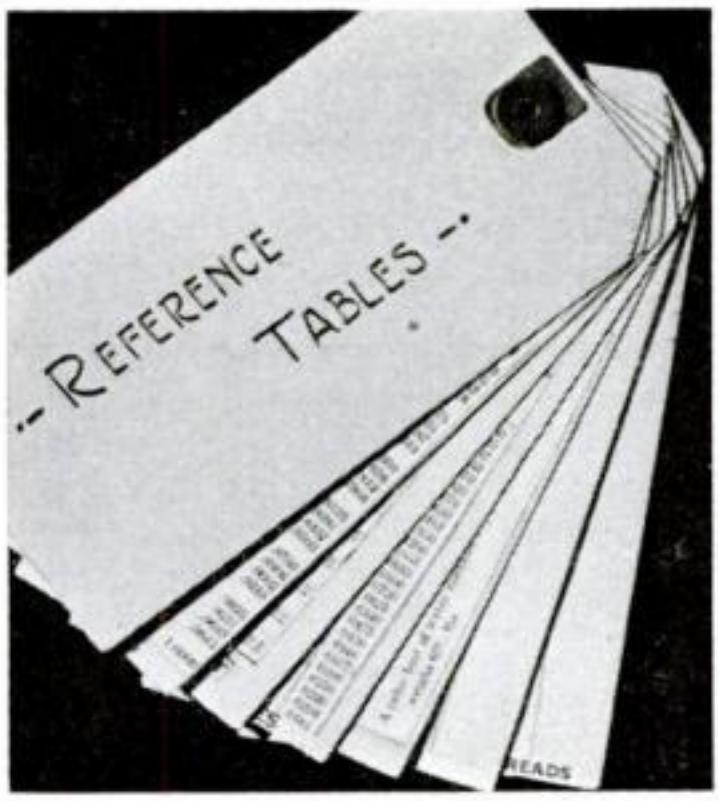
16 The final finishing tool has a long cutting edge that is set parallel to the machined surface and is fed by hand at 1/8" per stroke. One face is finished, and the work is again turned



17 Instead of the work being turned, the head could have been set at the opposite 45-deg. angle. A square shows both surfaces to be true

18 Following the machining of the small *V* and its rectangular slot in the same manner, all dimensions are checked against the blueprint

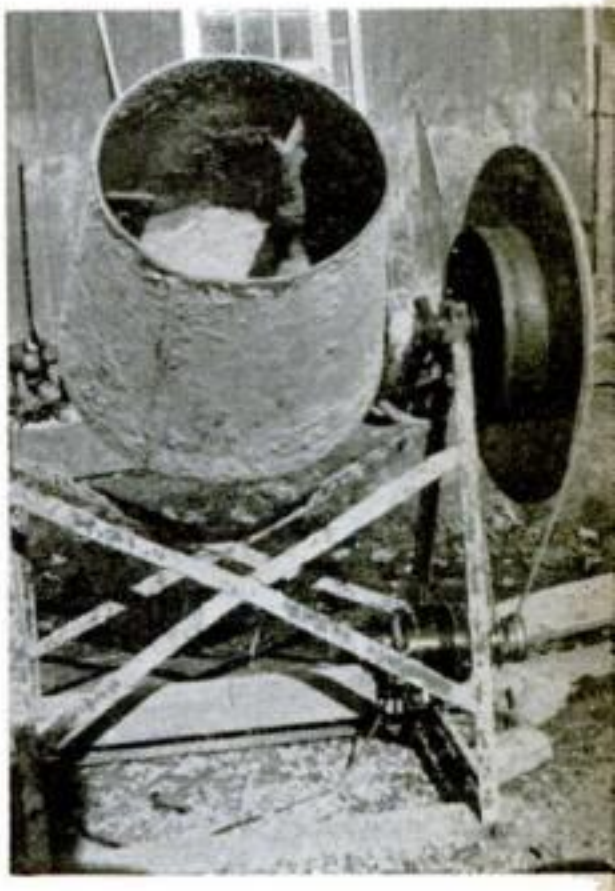
NEW SHOP IDEAS



SHOP DATA in the form of charts and tables can be kept handy by pasting it on large shipping tags. If the tags are then riveted loosely together, any one of the charts or tables can be fanned out for reference. Machinists, toolmakers, and mechanics can prolong the life of their expensive handbooks by cutting tables and charts out of magazines and manufacturers' catalogues and using them on the tags.—RONALD EYRICH.

A MAGNIFYING GLASS cemented to a cardboard ring and mounted over the safety window of a bench grinder is a great help in grinding tool bits and other precision work. The focal length of the lens should be such that the work is in sharp focus as it is held at the normal position against the wheel. For a typical bench grinder, a lens of about 10" focal length will be suitable, or a low-power reading glass can be pressed into service.—W. B.

SPLICED ROPE will serve in place of a long ⅜" or ½" V-belt. When cutting the rope, allow two to three feet for splicing. A transmission splice is preferable, but a long splice is also satisfactory if carefully made. The splice should be pounded with a mallet and rolled on the floor under one's foot in order to make it smooth and flexible. Coat the rope with belt dressing to make it wear longer and to prevent it from slipping. The motor should be hinged at one side so that only its weight tightens the belt.



THE LONG SPLICE

[KNOTS]

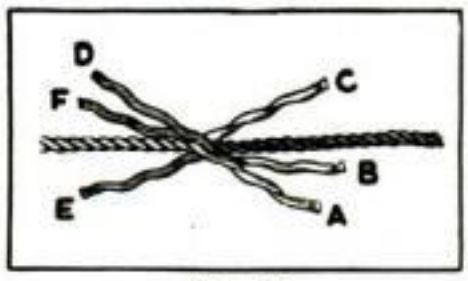


Fig. 1

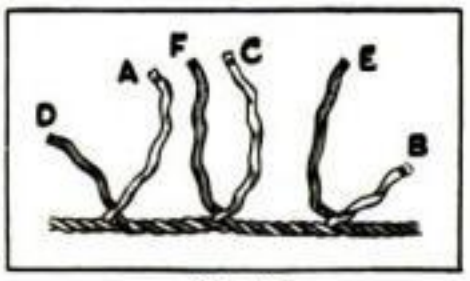


Fig. 2

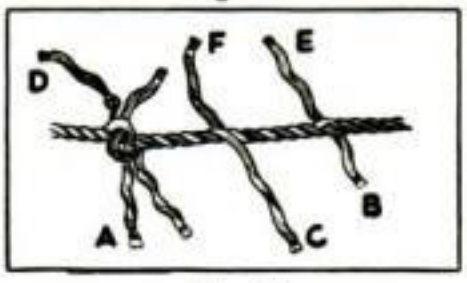


Fig. 3

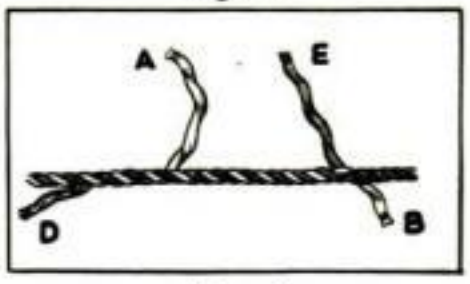


Fig. 4

Unlay the end of each rope about 15 turns and place the ropes together, alternating the strands from each end, as shown in Fig. 1. Start with any opposite pair, unlay one strand, and replace it with the strand from the other part. Repeat this operation with another pair of strands in the opposite direction, as shown in Fig. 2. Now tie each pair of opposing strands (Fig. 3) with an overhand knot like *B* and *E*, tuck each strand twice, then twice more.

Still another method of making a long splice is to halve each strand and tie it with an overhand knot before tucking. This method results in a smaller splice, but one with less strength. Roll and pound the splice well before cutting the strands off close to the rope (Fig. 4).

ANY DAY IS A GOOD DAY FOR TAKING

Pictures in Natural Light

ONE good day of brilliant sunshine will warm the heart of any camera enthusiast, but few of us realize that the sun can help us to produce just as excellent pictures even when it is hidden by clouds in the dullest kind of weather. Just so long as it gives enough light to register on your film, it will make a picture. What kind of picture depends on you—and especially on your ingenuity.

You have a choice of natural light as far as direction is concerned. If you decide that a certain building will photograph better with the sun shining on its western gable, you have but to wait until a certain time in the afternoon when that condition occurs. Most good pictures are planned, not made at a moment's notice. After you have chosen your subject, decide upon the quality of light you want when photographing it.

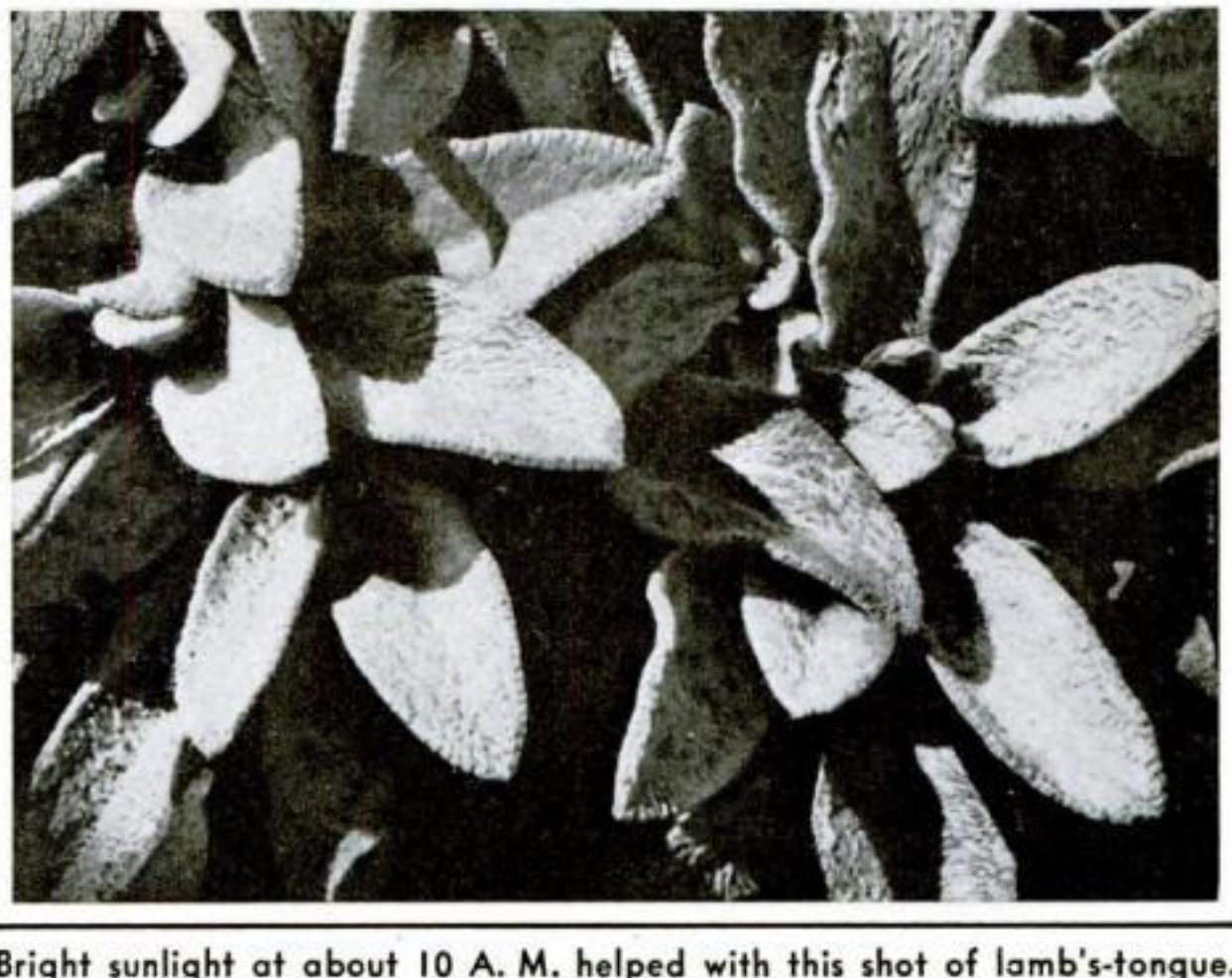
As the direction of the sun changes from east to west, the quality of its light also changes. The low-angle light of early morning and late afternoon is a form-revealing light that enables you to experiment with shadows and patterns to your heart's content. But remember that the light at sunrise and sunset is much redder than at other times of day, and that proper allowances must be

SUNFLOWERS at 2 P. M. with the light angle high in relation to the petals. This reveals form. A gray day in a railroad yard produced the dramatic shot below

BY
KONRAD CRAMER

made for this in calculating exposures.

For good results in photographing against the source of light, a lens shade is essential. A good type is the rectangular kind that is accurately designed for the viewing angle of the lens so that it does not block any part of the film area. A sun shield that permits shooting almost directly into the sun can be made easily from cardboard and soft wire. It is described in a short article on page HW 362 and shown in a drawing. Be sure to adjust it carefully.



Bright sunlight at about 10 A. M. helped with this shot of lamb's-tongue. A low angle of light puts half the area in shade for an all-over pattern

The best and quickest way to become familiar with the many effects produced by varying light conditions is to make the following experiment. Select an outdoor scene, which need not be photographically ideal but should be conveniently near your home. It may be a view from a window, a corner of your back yard, or the tree in front of your house. Shoot the same scene at intervals during the day —several times from dawn to dusk, including one exposure in the brilliant light of the noonday sun. You will be astonished to find how many different pictures the same subject will yield.

Illustrating this article are photographs of birch trees taken back of my house. These represent only two of many pictures of this same scene taken under different light conditions. When we consider light first and subject matter second, the quality of our pictures is sure to improve.

All light will become good light for picture taking, if we have a mind to make it so. Don't despise the soft and diffused light of a gray day, but do select the right subject to fit that kind of light. The picture at the left is an example.

The direction of natural light can be partially controlled by means of reflecting surfaces, such as a

DIFFERENCE IN LIGHTING the same scene is clearly shown in the winter sunrise at the left above and the sun and fog at right. Shooting into the sun is effective but difficult. In the sunrise photo, the only protection the camera lens had was afforded by the birch tree. Here is a commonplace subject transformed by proper illumination into excellent picture material, and many good views are possible

white cloth or a white wall. White sand or snow also will modify the original direction of light on your subject. A sheet of corrugated cardboard covered with pieces of tin foil that have been crumpled and then straightened makes an ideal reflector to control and modify light in outdoor portraiture. If made of two pieces hinged in the center, it will be portable and the tin foil will be protected when it is being carried.

Give the cardboard backing two coats of shellac. When the second coat is tacky, mount the tin foil. Then finish the piece by binding the edges with cellulose tape. Surfaces that are too smooth, like mirrors and pieces of bright tin, are not suitable for reflectors because they tend to produce harsh "spots" of light. In using a reflector, remember that light is reflected at the same angle at which it reaches the reflecting surface, just as a billiard ball rebounds from a cushion.

Intensity of light can also be controlled to a certain extent, especially in making outdoor portraits. For small areas, a child's wooden hoop or one made of a piece of wire can be covered with thin muslin or cheesecloth to temper the sun's rays where they fall on your subject.

Natural light, however, is not confined to

Cardboard Disk Protects Lens from Direct Sunlight

GOOD shots can be made almost directly into the sun with a lens shade designed as shown in this drawing. It is made by fastening a small disk of black cardboard to one end of a piece of soft wire. The other end of the wire is attached to the camera, permitting adjustment of the disk to keep the sun's rays from striking the lens.—K. C.

WISTERIA shot against the light is but one example of the large number of photographs of this class. Shooting against light requires two or three times the normal exposure; otherwise only a silhouetted figure will show

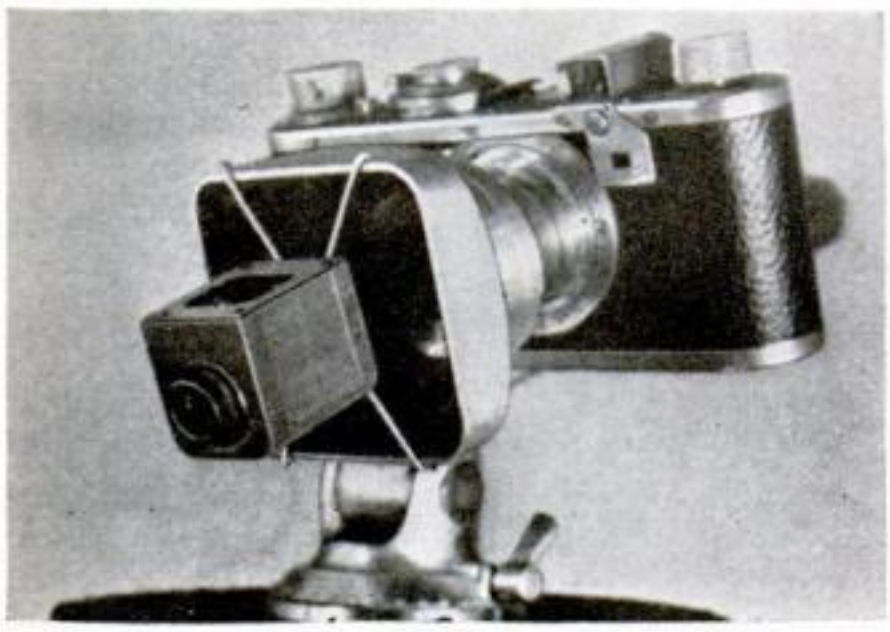
READING by a window with the natural light from outside as illumination presents this fine picture possibility. Too often the introduction of additional artificial light sources simply destroys both the character and the personality of the interior

outdoor photography. Some beautiful pictures are made indoors with natural light. Don't forget this just because such indoor light fails to register strongly on your meter —it may nevertheless yield good photos. If you have never made pictures either indoors or outdoors with exposures of many seconds, you have missed much of the real fun of photography.

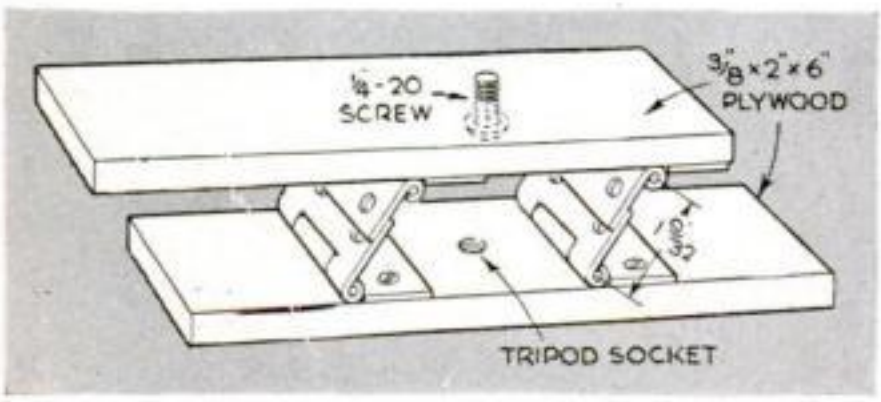
Many picture fans are apt to confine their activities to good-weather shooting. This is as limiting as though a musician confined himself to major scales only. The time has passed when photography could be practiced only in strong light. Get a new thrill out of your camera by discovering its possibilities under so-called bad lighting.

Whatever light you work with, always remember that film does not record it as you normally see it. Your eyes are sensitive to a much greater range of brightness than your film is. To teach your eyes to see light photographically, I suggest you make extensive use of a good viewing filter. Hang one around your neck and use it freely to look at scenes about you. The filter eliminates most of the color and helps you see things as your film does. One can be made from several layers of blue cellulose wrapping material sandwiched between two pieces of glass.

THE CLOSE-UP VIEW FINDER shown below can be adapted to fit any camera. It consists of a finder from an old camera fitted with a wire spider which clips on the sunshade. The view finder is held by the spider in front of and in line with the lens, so that there is no parallax. In order to make it possible to center the spider quickly and accurately, it is advisable to paint four spots on the sunshade at the places where the spider legs grip it. Compare the field of the view finder to that of the lens by checking it against a piece of ground glass held over the film track. With black paint, mask off the field of view of the finder so that it corresponds to that of the lens.—ROBERT F. BENENATI.



A CAMERA SHIFTER for taking still stereographs with a single camera is shown below Two pairs of hinges are soldered together with the distance between the center of the hinge pins measuring exactly 1 9/32". This distance is one half of the average spacing between the two shots taken of one subject in making a stereograph. The free leaves of the hinges are screwed to two plywood boards in such a way that when the hinges are folded together in one direction the ends of the boards will coincide. When the hinges are folded in the other direction, the top board to which the camera is fastened will shift 2 9/16". This device holds the camera rigid and makes the shift in camera viewpoint accurately.—WILLARD ALLPHIN.



EXPOSURE RECORDS are usually kept by the amateur, especially if he is working with a new type of cut film. It is sometimes difficult to remember in which order the exposures were made. For a foolproof system of numbering the negatives, just include the number in the composition where it will register on the film, yet be readily cropped out. In the photo above, a desk-calendar number was shot in the picture.—L. H.

PAPER DEVELOPER can be stored economically if it is removed from its large container and poured into small bottles. The ½-gal. package made into solution will fill eight 8-oz. bottles which, if tightly capped, may be stored indefinitely. As the majority of such solutions are diluted two to one, 8 oz. of stock solution make up 24 oz. of working solution, which is usually sufficient for the amateur's use.—HARRY F. LEEPER.

This "heavenly" picture was shot in a very earthly studio. The assistant, kneeling behind the chair as at the left, tilted it backward at the instant the shutter was opened

HUMAN SHOOTING STAR. In snapping this unusual photograph, advantage was taken of the fact that a moving light object before an open shutter will register its trail on the film.

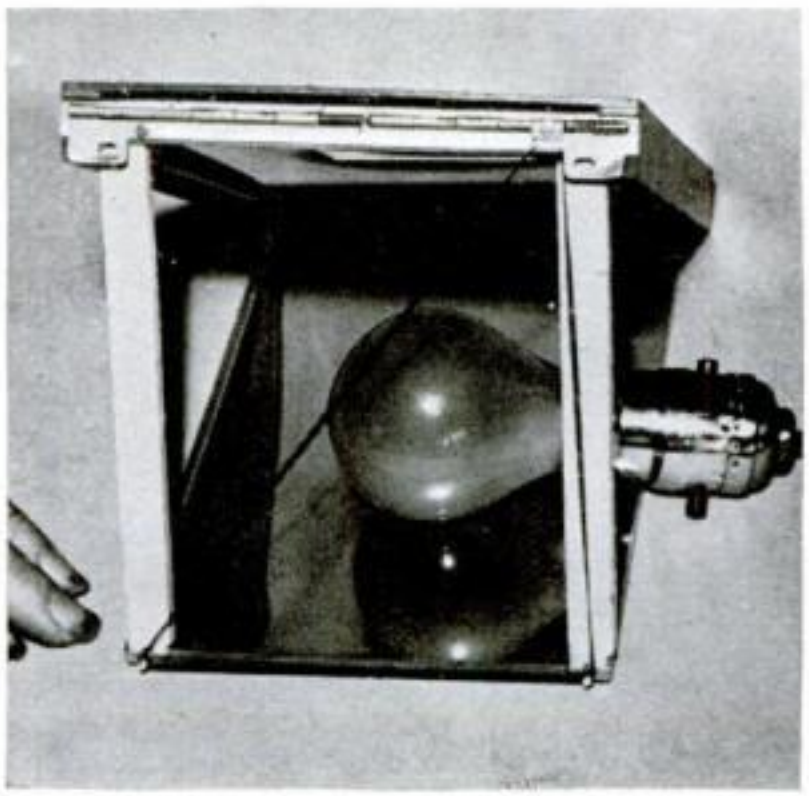
The model, covered up to the neck with a black drape, was seated on a chair before a black background. A spotlight set before her illuminated only her features, thus making it impossible for the black materials to register on the film. An assistant hidden under the drape behind the chair gripped its back. The shutter was set for "time."

At the instant the shutter was opened, the assistant was given a signal and immediately proceeded to tilt the chair backward on its legs. This left a light trail on the film that was terminated by closing the shutter when the model's head passed a certain point. Her features registered at the start of the trail because there was a slight delay in the reaction of the assistant to the signal, so that the model remained posed for a fraction of a second before moving backward. The stars were retouched later on the negative.—LOUIS HOCHMAN.

AN OLD FILM-PACK ADAPTER can be readily converted into a serviceable retouching stand at very little cost. A piece of cardboard inserted in the frame contains a window the size of the negative for the admission of light and serves as a backing for holding the negative against the glass. The glass plate should be the same size as the adapter frame and is held in position with two small nails at the bottom of the frame. Two wooden supports 3/16" by ½" by 6" are held against the frame with a rubber band over the slide clasp and two catch points. A small bulb illuminates the negative. If daylight is needed in addition to the light from the bulb, a small mirror may be attached to the frame.

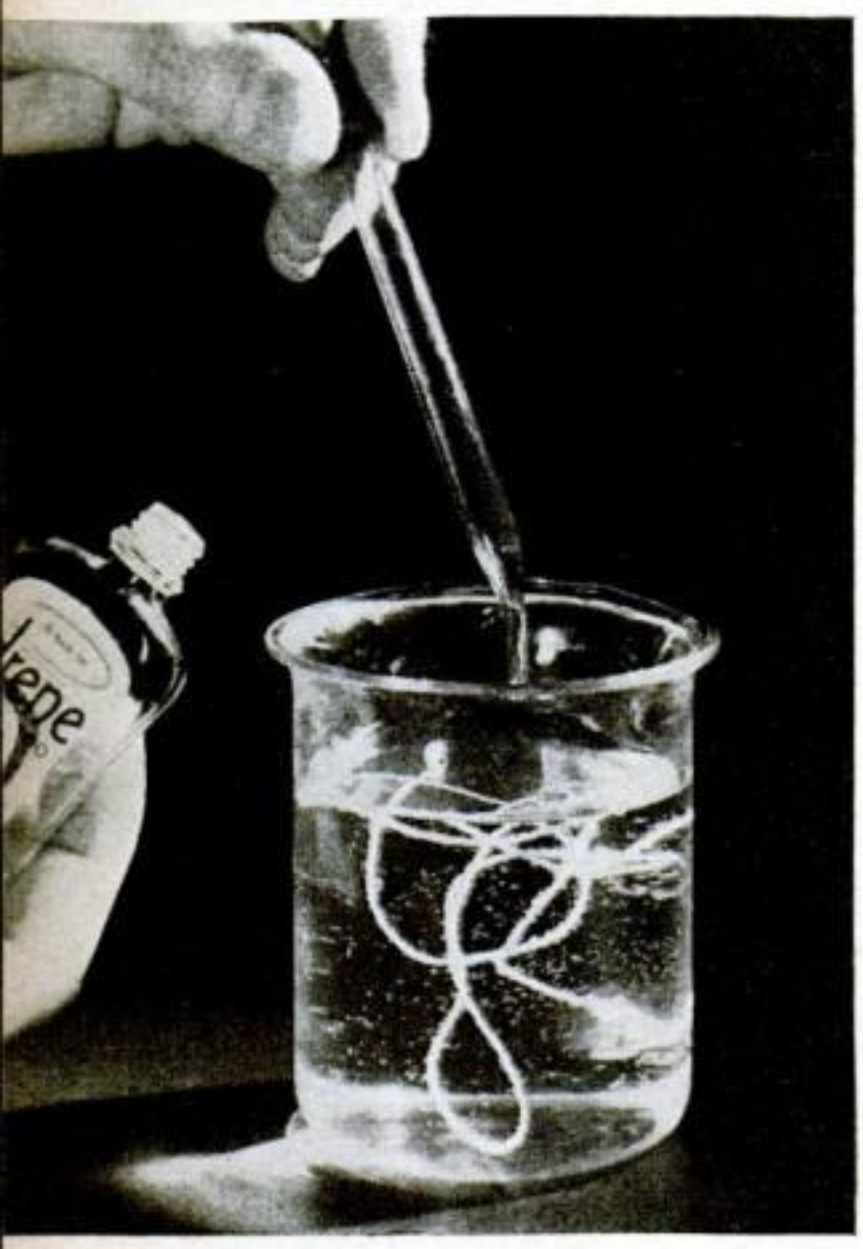
This method of conversion does not damage the film-pack adapter in any way for future use. However, if there is no further use for the adapter, the stand can be built on a more rigid base.—JOHN K. KARLOVIC.

A mirror placed in the bottom of the stand as shown below acts as a daylight reflector



Retouching becomes an easy job if you build one of these stands from your old film-pack adapter

Experiments with Water show How Surface Tension Acts

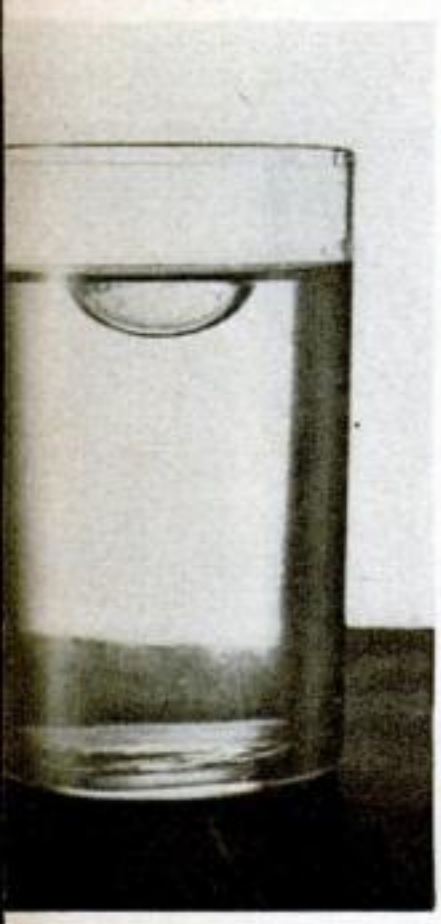


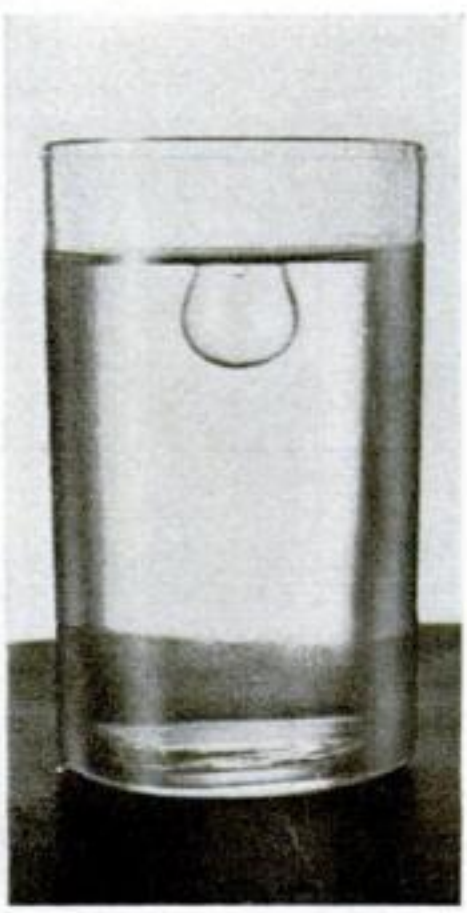
WHY are drops of water round? Why does water wet some objects and not others? How is it possible to float an object heavier than water? The answer is *surface tension*—the tendency of a liquid surface to act like a stretched elastic membrane.

When water is in contact with air, the molecules at the surface are attracted more strongly to the water beneath than to the air above. As a result, a thin membrane of molecules stretches itself over the surface. A needle or razor blade placed on carefully will not sink; it will merely dent the surface and float.

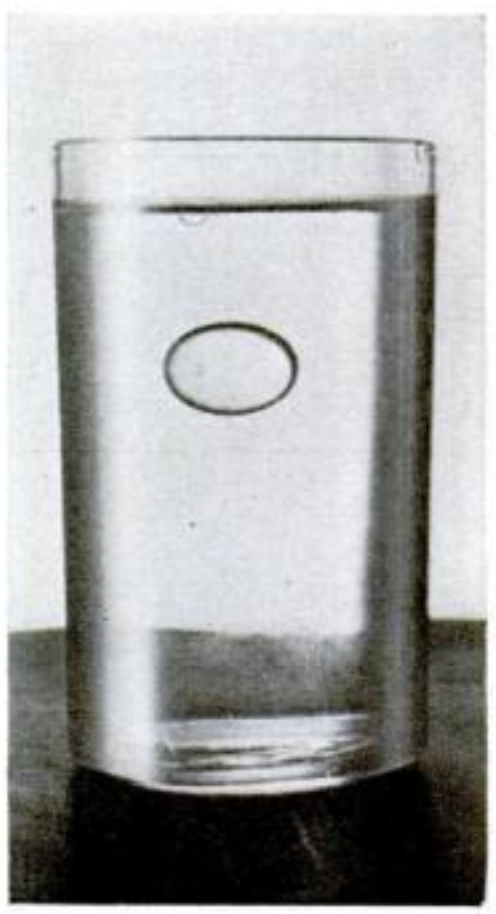
When water or other liquids are freed from the action of gravity and other outside forces, the

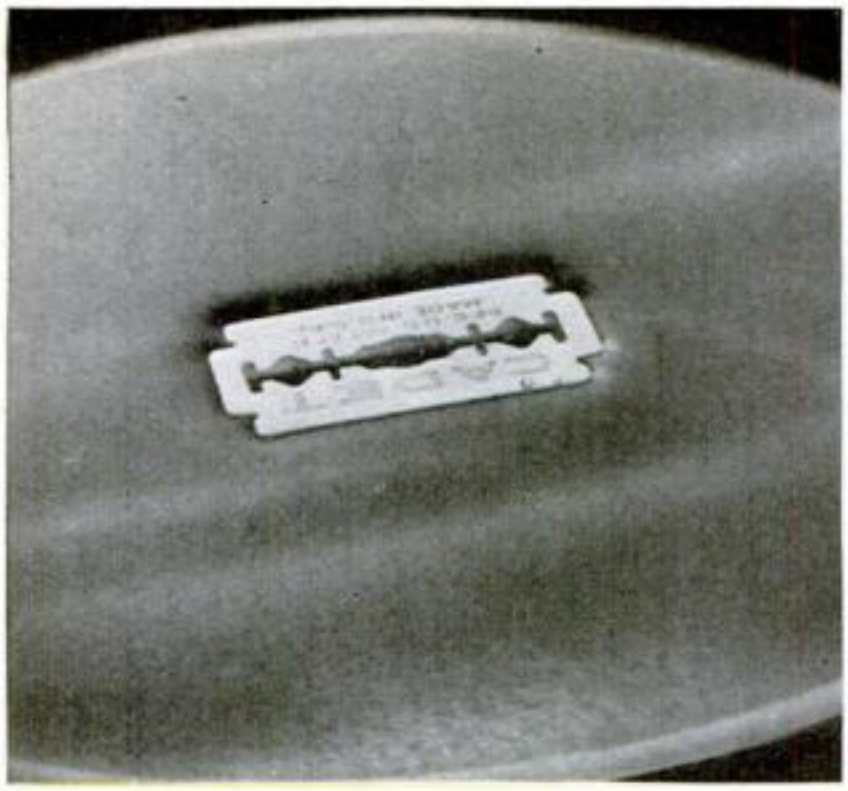
PUT SOME STRING on the surface of clean water as shown in the photo at the top of this page. The string will float, and the water will hardly wet it. However, add a few drops of some soapless shampoo to the water, and the string instantly sinks to the bottom. The shampoo acts as a "wetting agent," lowering the surface tension of the water until it is less than the attractive force of the string. This causes the fibers of the string to become soaked, and it sinks.



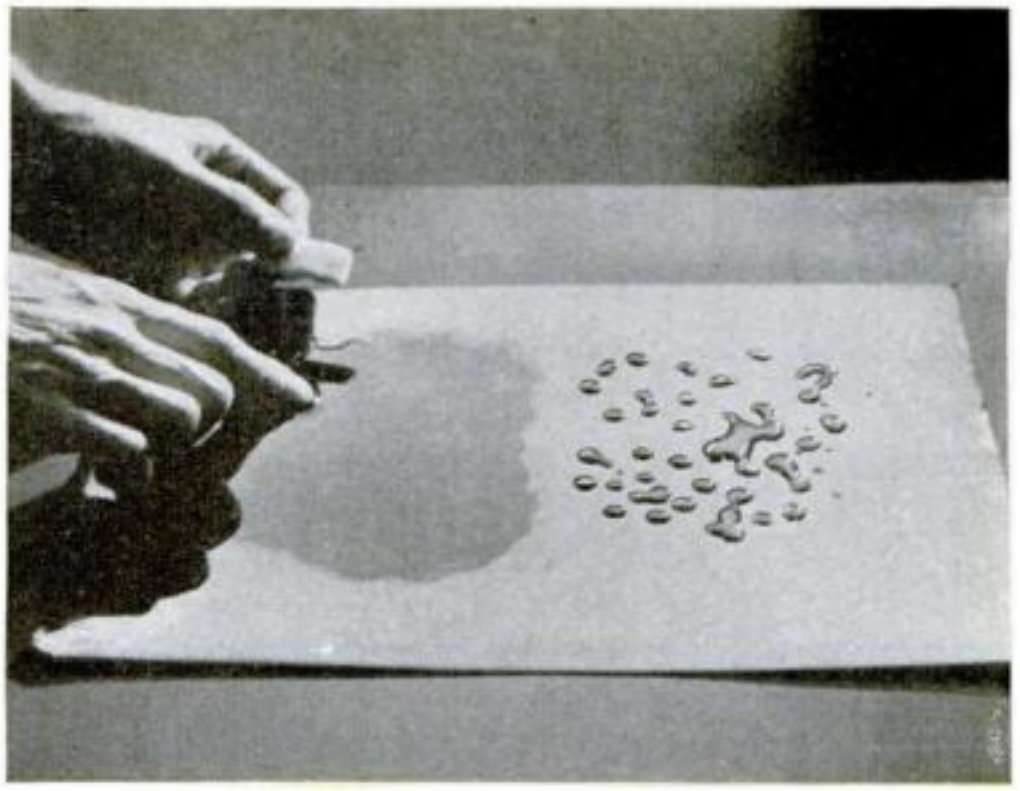


DROP OLIVE OIL on a mixture of water and a little alcohol. The oil will sink just beneath the surface, as at the far left. Add more alcohol slowly, and the oil will sink further, as in the next photo. Still more alcohol will finally cause the oil to float beneath the surface. It then assumes a spherical form because of surface tension. At the right, the globe seems flattened, but this is an illusion caused by the water.





PLACE A RAZOR BLADE on the surface of some clean water, and the blade will float. If you look closely, you will notice that the blade is a trifle lower than the surface, and that the water bends down as if a film were stretched tightly over its surface. This occurs because the molecules of water have a stronger attraction for each other than they have for the razor blade, hence the blade floats on a surface film of water.

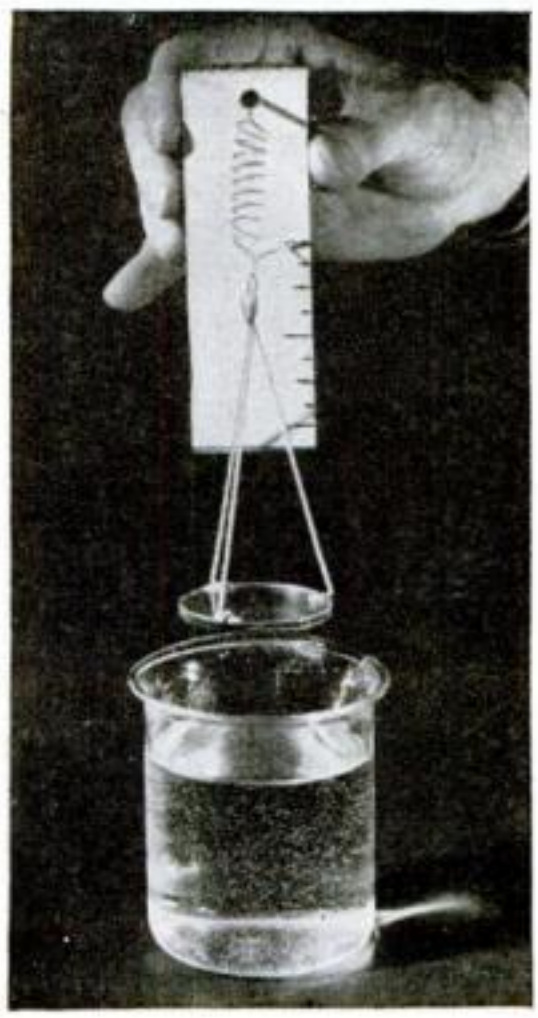


ENAMELED FERROTYPE TIN of the type used in photography will cause water poured on it to draw into little globules, as at the right in the photo above. The cohesive force between the water molecules is stronger than the attraction between the water and tin, so they arrange themselves to present the smallest possible surface. Soap added to the drops will allow them to be spread over the plate as at the left in the picture. The surface tension of the water is lowered by the action of the soap, and the plate becomes thoroughly wet.

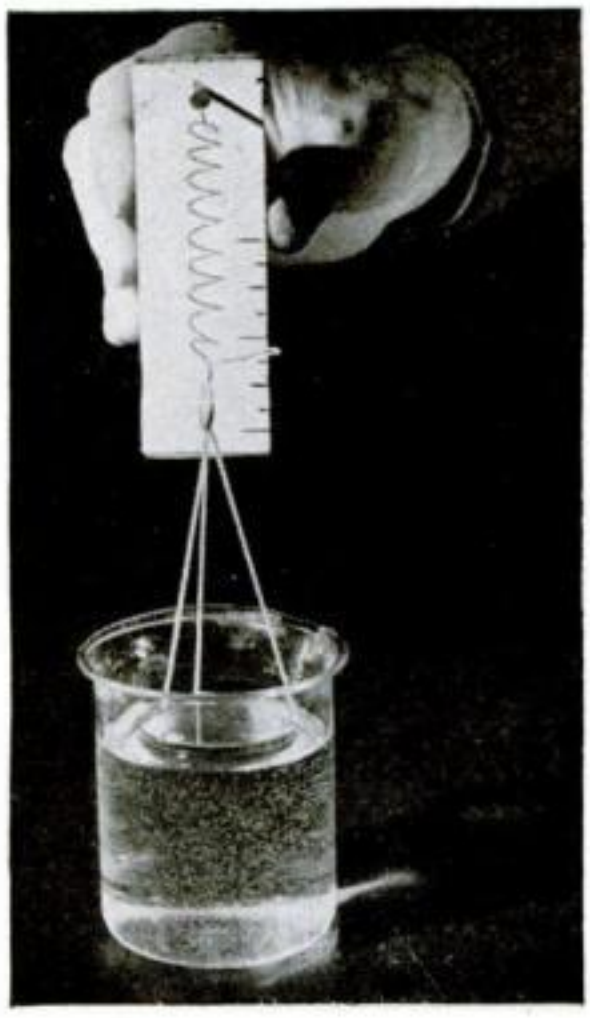
cohesive force of the molecules pulls the surface into a sphere—the form possessing the smallest possible area.

Such materials as cotton or wool attract the molecules of water strongly. Oily or waxed surfaces are harder to wet, having less attraction, but some agents will aid by reducing the surface tension of water. One of these is ordinary soap.

The accompanying striking examples of surface tension are easily duplicated, and the results are interesting to watch.



SURFACE TENSION may be easily measured with the simple apparatus shown. A clean glass disk is supported from a light spring made from a dozen turns of fine wire. Before touching the disk to the water surface, the extension of the spring is noted. Lower the disk squarely on the surface. If you now attempt to lift the disk, you find that the water holds it down, stretching the spring far below its original position. You can test the surface tension of other liquids with this same method.



SILICON..

THE SOCIABLE ELEMENT

Though Its Compounds Just About Cover the Earth, It Cannot Be Found Alone

By KENNETH M. SWEZEY

You can demonstrate how glass is made by mixing **equal parts of sand, sodium** carbonate, and lead **oxide. These are melted** in a porcelain crucible

ALTHOUGH silicon can never be found alone, its compounds make up more than a quarter of the earth's crust. Common sand is silicon dioxide, or silica, as are the minerals quartz, agate, amethyst, and opal. Almost all rocks, except limestone, contain this vital element. Sandstone is merely silica bonded with clay or lime. Feldspar and clay are both compounds of silicon and aluminum. Silicon carbide, used as an abrasive, is an artificial compound produced by heating silicon dioxide and carbon in an electric furnace.

One of the most important and familiar artificial compounds of silicon is glass. Ordinary window and bottle glass is a mixture of silicates produced when white sand (which is almost pure silica) is melted with sodium carbonate and lime. When potassium oxide and lead oxide are substituted for sodium and lime, glass with a low melting point and high index of refraction is formed, which is especially suitable for lenses. Different types of glass may be made by other slight alterations in the composition.

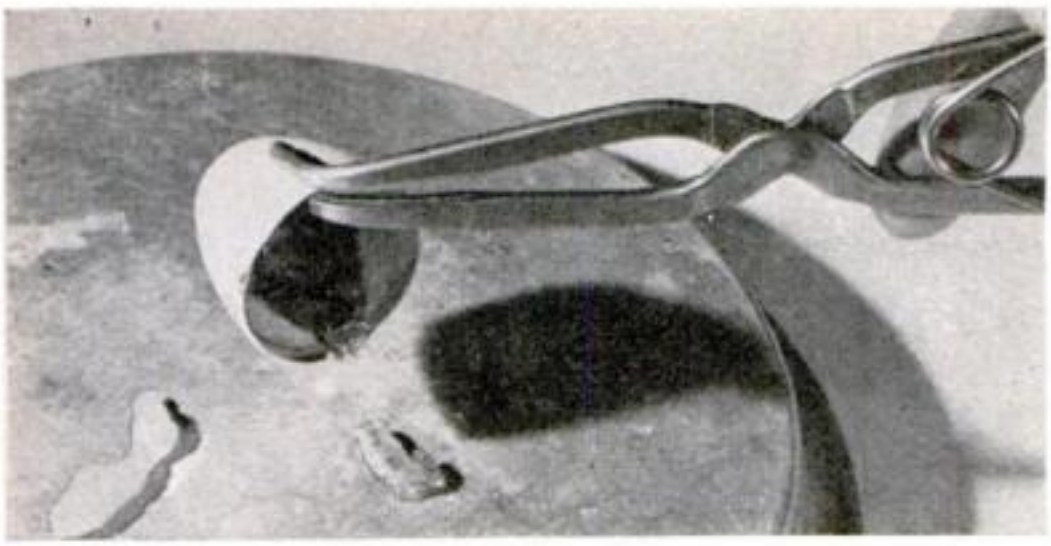
With a small porcelain crucible and a Fisher or Meker burner, you can easily make and color bits of glass in your home laboratory just as it is done in industry.

Because of its lower melting point, it is better to experiment in making lead glass, rather than glass containing lime. Mix about 3 grams of clean white sand with equal weights of dry sodium carbonate and yellow lead oxide. Put this mixture in a crucible and heat it strongly until it melts into a fluid mass. Pour the contents on the bottom of a pie tin or on an asbestos mat, and the drops that form will become, upon cooling, sparkling bits of real glass.

You may color your glass by adding to it a trace of some metallic oxide while it is still in its molten form. Cobalt oxide produces blue glass—chromium oxide colors it green. Used in minute quantities, manganese dioxide produces amethyst glass, while larger quantities color it black. Colloidal gold turns glass a beautiful ruby red. The bright red of traffic lights and automobile taillights is generally produced by the addition of selenium.

Compounds of silicon owe much of their usefulness to the fact that chemically they are extremely stable. They resist all common acids, except hydrofluoric, and they are also little affected by bases, except hot sodium or potassium hydroxide. This inactivity explains why most chemical containers and laboratory apparatus are made of glass, and why buildings of glass, brick, and stone have been able to weather centuries.

The resistance of silica to acids and bases makes it of special value to the carpenter



The melted mixture is poured on a tin plate or asbestos pad, where it forms globules of glass

A fairylike chemical garden is produced if you drop the salts of heavy metals such as copper sulphate, zinc sulphate, nickel sulphate, cobalt chloride, and the like into a solution of water glass in water. The compounds form insoluble silicates which literally grow before your eyes, taking on fantastic colors and shaper as they rise to the surface

and home craftsman. In the form of silex, an extremely fine sand made from quartz rock, it serves as a base for wood fillers that is totally unaffected by vapors in the atmosphere or chemicals in paint.

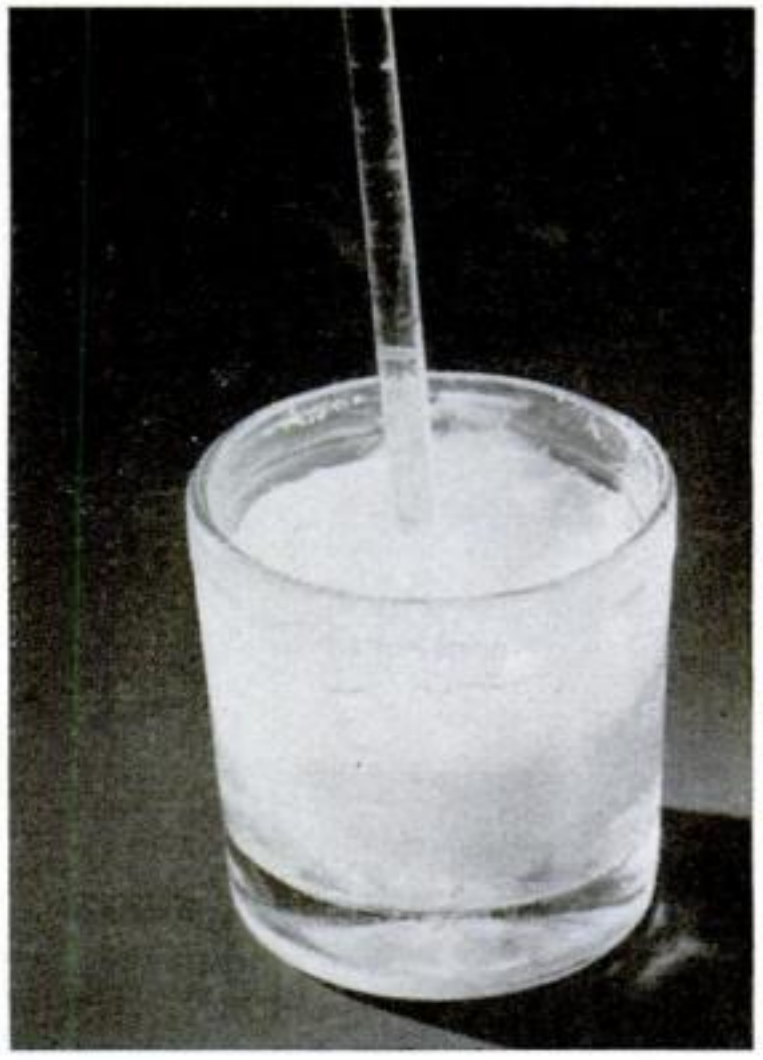
Because hydrofluoric acid dissolves, or "eats," silica and glass, it is used extensively for glass etching. Commercial acid is supplied in wax bottles. If you have none, you can make a crude form by mixing sodium fluoride, which is sold as a common insecticide, with concentrated sulphuric acid.

If you want to etch an initial on the side of a plain glass tumbler, first warm the glass; then apply a coating of paraffin a little larger in area than the initial desired. Build up a frame of wax completely around your wax panel, high enough to hold the etching mixture. Then scratch away part of the wax to form the initial. Cover the panel with a layer of sodium fluoride. *(Be careful not to breathe this powder or get it into cuts or in your mouth, as it is very poisonous.)* Drop sulphuric acid on this until a creamy paste is formed. Let this stand for about ten minutes; then carefully wash off the etching material, remove the wax, and there is a perfect initial.

Of all the silicates, only potassium and sodium silicates are soluble in water. Sodium silicate solution is the well-known water glass, used extensively for making cements, for fireproofing, and for preserving eggs. With the sirupy variety, you can make cement for glass and china. Dilute it, and you can produce a gel and a chemical garden.

You can use thick water glass alone as a good transparent cement for glass or china. First heat the edges to be cemented; then apply the water glass. Clamp the parts tightly together until the water glass is dry. A cement that will stand acids and high heat may be made by mixing two parts of the thick water glass with one part of fine sand and one part of ground asbestos.

To make a gel, two solutions must be prepared. The first is made by diluting 15 ml. of thick water glass with an equal amount of water. The second consists of



If you pour together into a small glass or beaker a solution of dilute hydrochloric acid and a solution of sodium silicate, almost immediately a solid white mass will form that will support the stirring rod as at right. This is silica gel, which, in its dry form, is used as a dehydrating agent

2 ml. of concentrated hydrochloric acid diluted with 20 ml. of water. Pour these two solutions simultaneously into a small glass or beaker, and immediately stand a stirring rod in the center of the beaker. Within a few seconds, the clear solutions will have united to form a solid whitish gel that will support the rod and will not fall out if the beaker is inverted. When dried, this silica gel contains millions of microscopic pores that will take up quantities of water. It is widely used as a drying agent.

A chemical garden affords a beautiful experiment which no home chemist should miss. Obtain a small fish bowl or a low jar that will hold about 1 qt. and sprinkle a layer of coarse sand about ¼" deep on the bottom. Fill the remainder of the bowl or jar almost to the top with water glass diluted with an equal amount of water.

"Seeds" for your garden consist of salts of the heavy metals, such as copper sulphate, nickel sulphate, cobalt chloride, ferrous sulphate, zinc sulphate, and manganese chloride, which are dropped to the bottom of the globe. In an hour or two the garden should be completely grown—a forest of intricate and varicolored growths.

After a day, the sodium silicate solution may be carefully siphoned off and replaced with clean, fresh water. As the "plants" all consist of metallic silicates, they are insoluble. They should last until they are broken down by jarring.

Scratch an initial on the waxed surface of a tumbler, cover with sodium fluoride, add sulphuric acid, and let stand about 10 minutes. Remove the chemicals, and a perfect initial will be formed on the glass

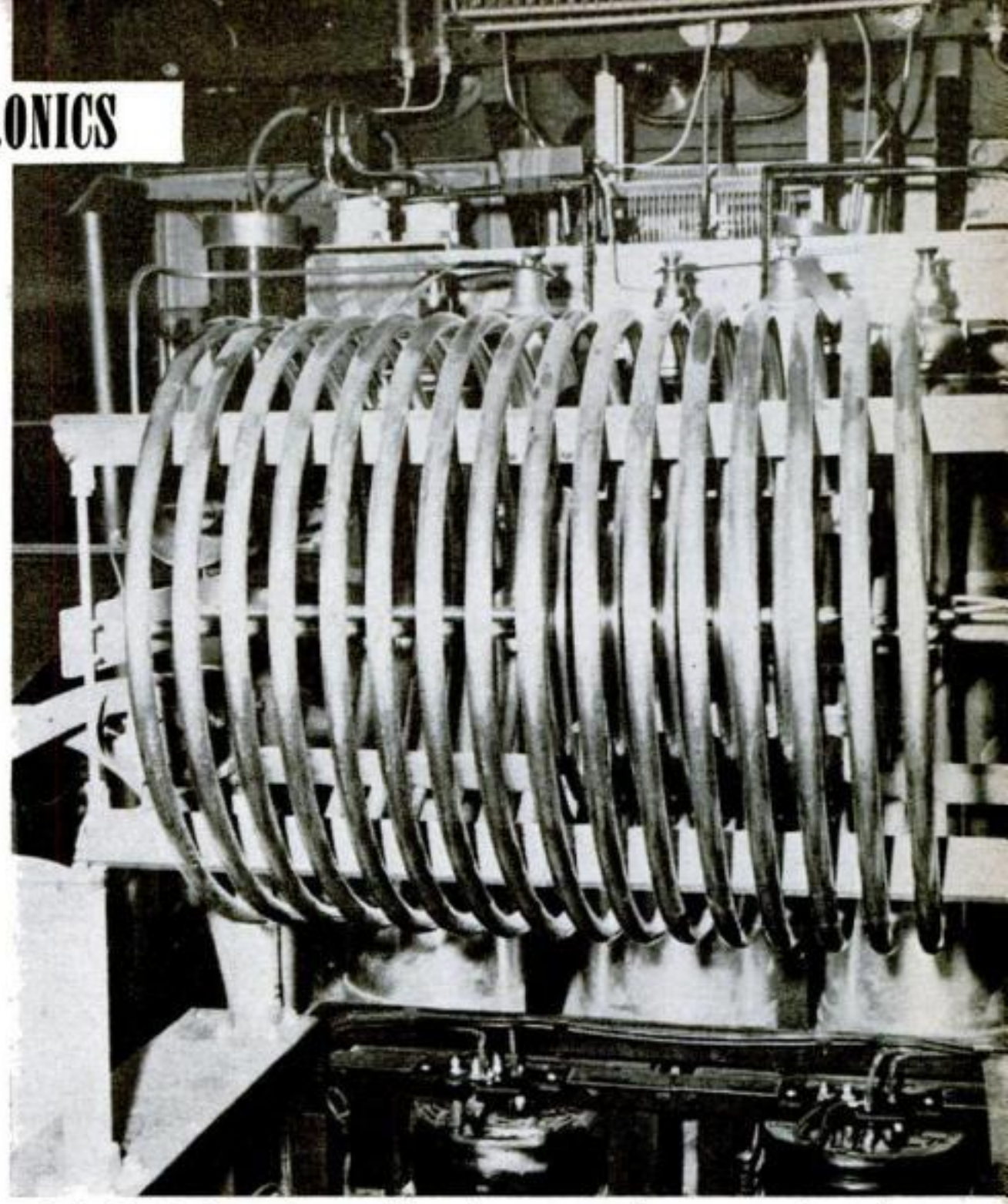
HW 370

FIRST STEPS IN ELECTRONICS

By JOHN W. CAMPBELL, JR.

THE storage of electrostatic energy in a condenser and electromagnetic energy in an inductance coil give rise to one of the most useful tricks of the whole science of electronics —the phenomenon of electrical *resonance.*

An electric current, whether it is in a copper wire or a vacuum tube, consists of a movement of electrons, and in either case obeys the same basic laws. As a matter of fact, as far as an electron is concerned, a copper wire is a sort of vacuum tube filled with a coarse, rigid grating of immobile copper atoms. Trillions of planetary electrons wander at random among the fixed nucleuses of the copper atoms, restrained only from leaving the surface of the wire. However, if an electric current flows through the wire, this horde of electrons drifts slowly in one direction, like a crowd leaving a football field through a tunnel. The apparent speed of electricity is due to the fact that the instant an extra electron is pushed in at one end of the wire, a corresponding one is pushed out at the other.



Goliath of the radio world is this giant inductance coil used in the transmitter of station WEAF to smooth the power output

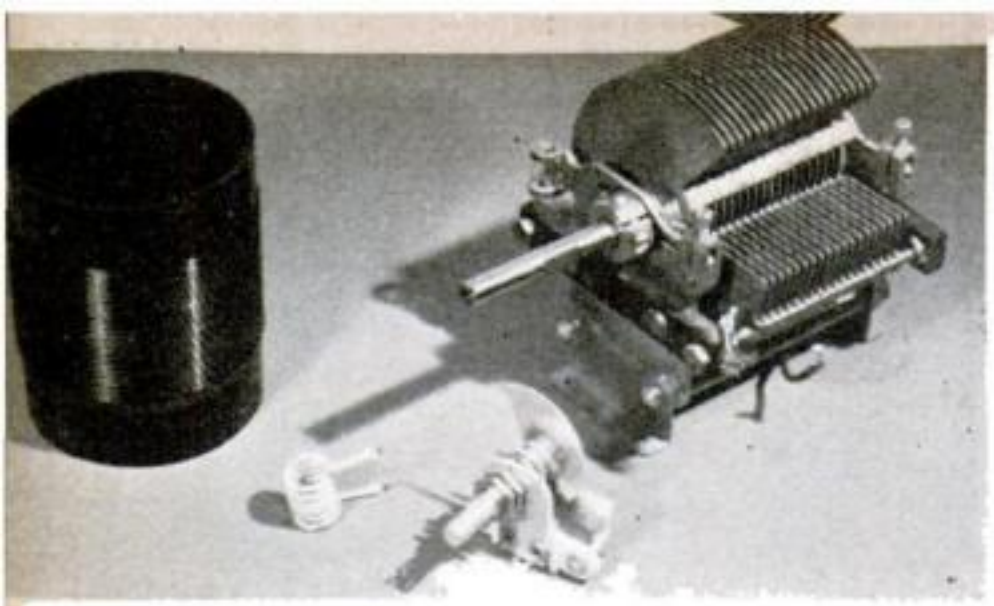
RESONANCE EXPLAINS

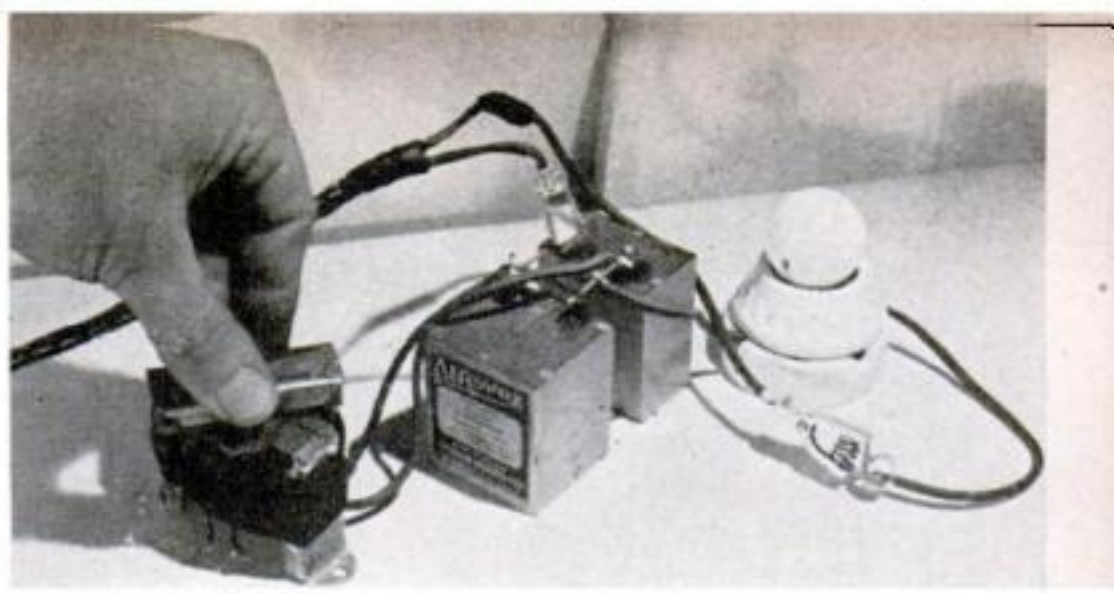
The Mystery of Tuned Circuits

Resonance, however, can stir those electrons up so that, instead of wandering gently along, they surge back and forth in the wire and spill over like waves in a bathtub. This movement now becomes a dangerous thing—so dangerous that resonance is to be avoided in any application where there is a considerable current.

Resonance can turn tiny voltages and minute currents into readily detectable surges of energy, which is why the radio engineer employs it. The electrical engineer, on the other hand, must make sure that his power lines don't accidentally get into resonance and turn 110 volts at 50 amp. into 10,000 volts at 5,000 amp.

If you have a charged condenser and connect an inductance coil across its terminals, the excess electrons on the negative plate of the condenser will enter the wire and push enough electrons out of the far end to satisfy the lack on the other condenser plate. But that flow of electrons builds up a magnetic field in the inductance. With the condenser now discharged, the current tends to stop flowing; but then the





Above left, compare the inductance of many turns and the big variable condenser found in standard radio receivers with the six-turn coil and single-plate condenser employed in short-wave and FM sets. In the photo at right, a resonant circuit that can be tuned as a wave trap for 60-cycle current

magnetic field it has established must collapse, and in collapsing it cuts the coil, driving the electrons onward again. They are crowded onto one plate of the condenser, and presto! the condenser is charged again—this time in reverse.

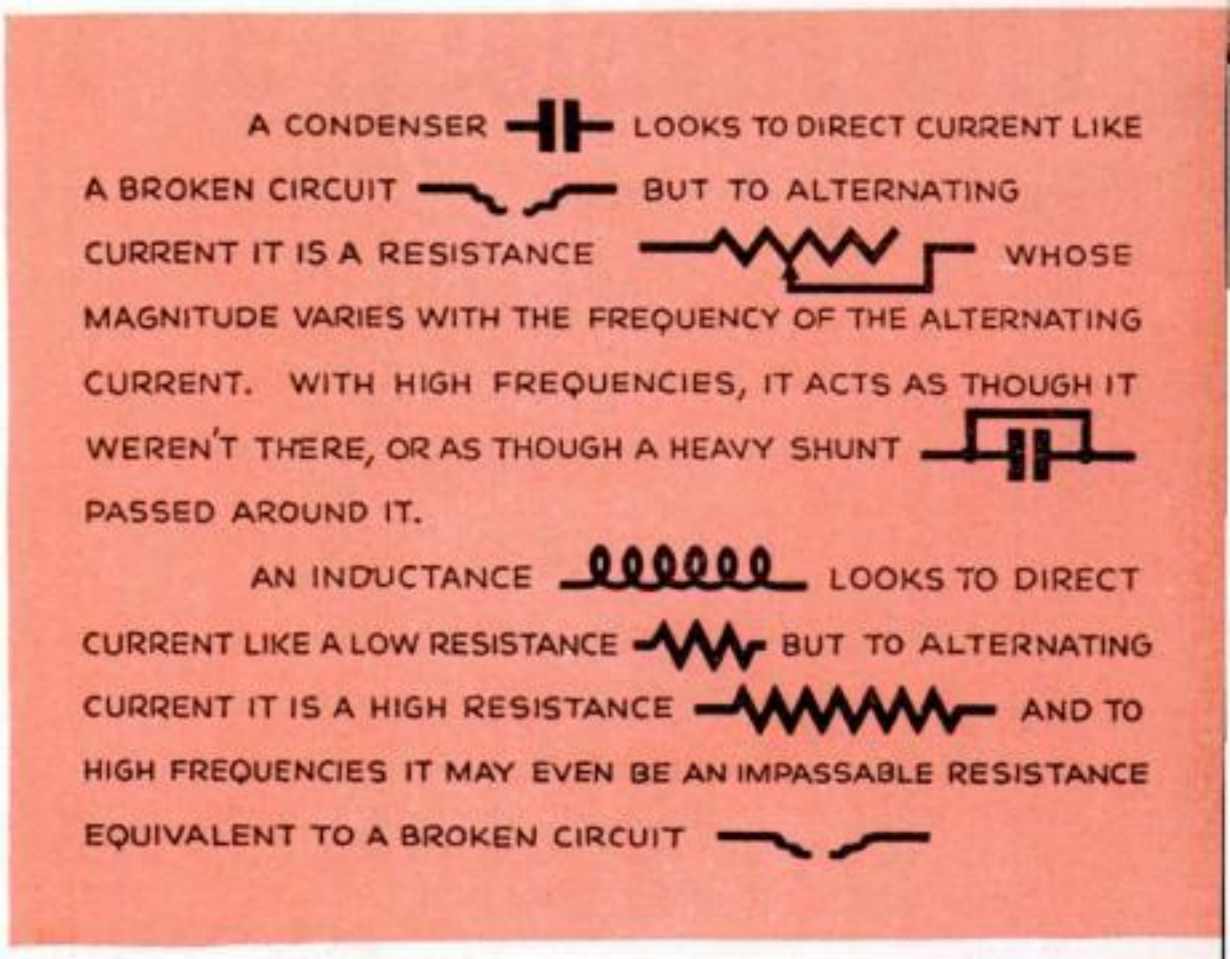
Immediately the cycle repeats itself. Round and round it goes, and it comes out as heat that develops in the resistance of the wiring and as radiated electromagnetic energy, or radio waves. If it were not for the gradual dissipation of energy in these forms, the electrons would continue to surge back and forth forever, for the system is an electrical equivalent of a pendulum.

A heavy pendulum can be started swinging if it is tapped lightly with a pencil in time with its natural rhythm. Likewise, trillions of electrons in a copper wire can be made to surge back and forth with tremendous violence. It takes a certain amount of time for the discharging condenser to force its excess electrons through the magnetic reaction of the inductance; it takes time also for the inductance to force electrons back into the condenser again. With every combination of inductance coil and condenser there is a certain natural rhythm. Find that rhythm and give the electronic pendulum little electric pushes at just the right time, and the whole horde of electrons in the copper wire will take on an oscillating motion. The separate spurts of energy pushed in on each swing add up, the electrons surge more and more violently, the current through the inductance becomes greater, and voltages pile higher on the condenser.

A radio signal captured by an aerial, so minute as to be measured in millionths of an ampere, when fed into a perfect resonant circuit will start the electrons in the wire swinging until quite detectable currents charge back and forth through the inductance coil.

However, you can't drain off heavy currents or high voltages continuously. A resonant circuit is only a reservoir of energy, just as a condenser or inductance is. But where these and all other electrical storage devices store D.C. energy, with positive and negative neatly separated, a resonant circuit stores A.C. energy. The result is a condition hard to understand at first glance, because the electric current is present but not working. As long as energy is merely transferred from one storage tank to another and back again, it is in reality doing no work.

This is possible because, in alternating current, the current and voltage can be going in different directions at the same time—they can be "out of phase" with each other, as shown in Fig. 1. In a perfect parallel resonant circuit (Fig. 2) the current in the condenser and the current in the inductance are, at any given moment, going in exactly opposite directions, and the voltage in the inductance is going in exactly the opposite direction from the current in the



inductance, while an A.C. line feeding the resonant circuit. if it is "in tune," is 90 deg. out of phase with both the condenser and the inductance. This condition gives the resonant circuit an infinite impedance—no current can flow into it.

This phenomenon is easily demonstrated. Filter condensers and an inductance coil or audio-frequency transformer from one of the old "all electric" radio models will serve. A 7½-watt, 110-volt light bulb will act as your "ammeter."

If we were to put our electric-bulb "ammeter" in the resonant circuit itself, it would consume energy. Since a resonant circuit is an energy-storage system, a constant drain of energy to operate the lamp would prevent it from operating as a resonant circuit. But if we put a resonant circuit in series with the lamp, it will have a high impedance when it is tuned to match the frequency of the 60-cycle power line, and the lamp will go out. At any other tuning, the 60-cycle current will pass, and the lamp will glow.

In the circuit of Fig. 2, using a filter condenser of about 2 mfd. and an inductance of 3.5 henries, resonance is at 60 cycles. The relationship of inductance, capacitance, and frequency in a circuit is such that if either the inductance or the capacitance is increased, the natural frequency of the circuit is lowered. Radio practice tunes the resonant circuit of the set by varying the capacity of the condenser; in the early days fixed condensers and variable inductance coils were frequently used. Since a 2-mfd. variable condenser would be too huge, we shall use this latter system.

The setup in Fig. 2 consists of two 1-mfd. filter condensers in parallel across the primary windings of an old audio-frequency transformer, the resonant circuit so formed being in series with a small lamp and the 110-volt, 60-cycle power line. The secondary of the transformer is not used. This transformer had a core consisting of an E-shaped section and a separate leg clamped together. By cutting the sheet-metal strap away, the leg was freed. The effective inductance of the winding could then be altered by adjusting this loose leg to coincide more or less with the other section. At some point in changing the position of the armature, the circuit is in tune with the 60-cycle current. No current passes, and the lamp is dark. In any other position, the circuit is tuned to higher or lower frequencies, and the lamp lights, showing that 60-cycle current can pass.

The frequency to which a circuit is tuned is determined by the product of the inductance multiplied by capacitance; for 60 cycles the value is approximately 7 mfd. henries. If the product of capacitance and inductance in the circuit of Fig. 2 were made 0.07039 mfd. microhenries, 100,000,000 times smaller, the circuit would be tuned to 600 kc. in the broadcast radio band and would serve to block the passage of a 600 kc. radio signal. That is the principle of the wave trap used in series with a radio aerial to cut down the strength of a powerful signal from a near-by transmitter while letting other stations in unhindered.

Since your old radio contained tuning condensers and inductance designed for broadcast-band use, you can substitute them as in the circuit of Fig. 3 and have a wave trap for use with any receiver.

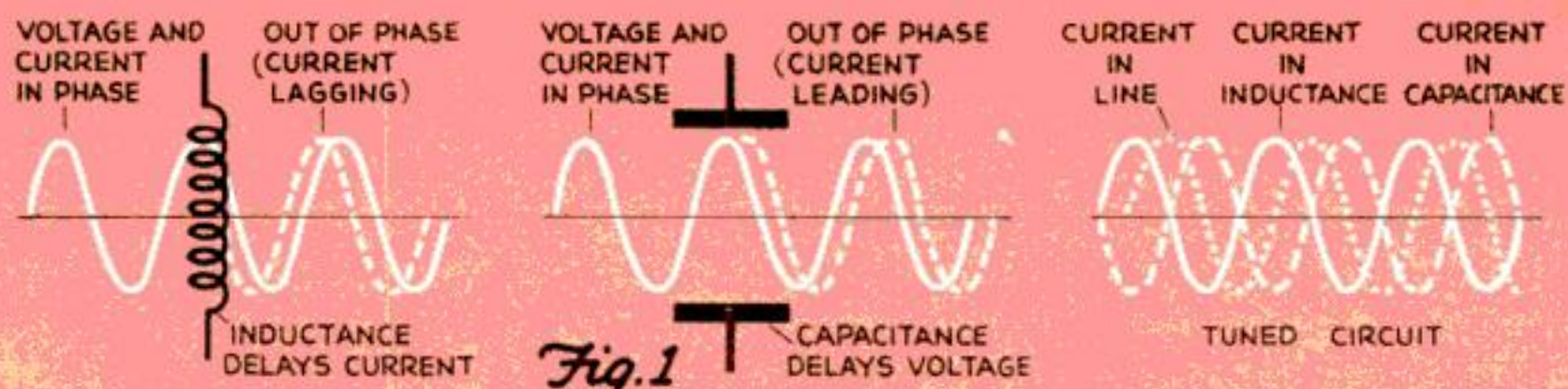


Fig. 1

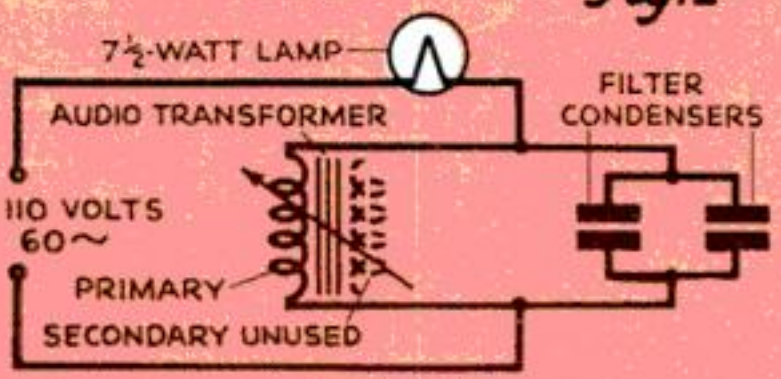


Fig. 2

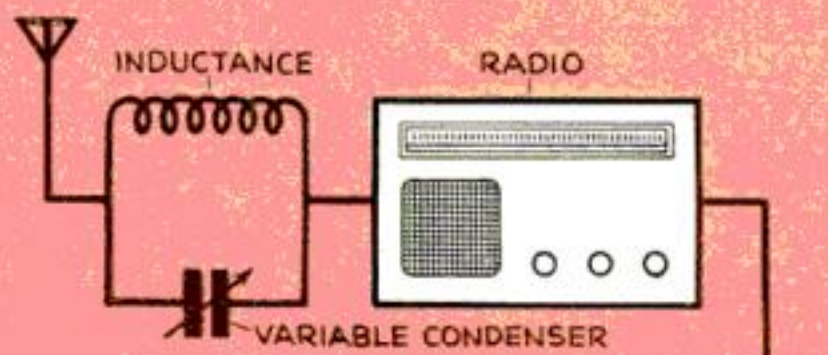


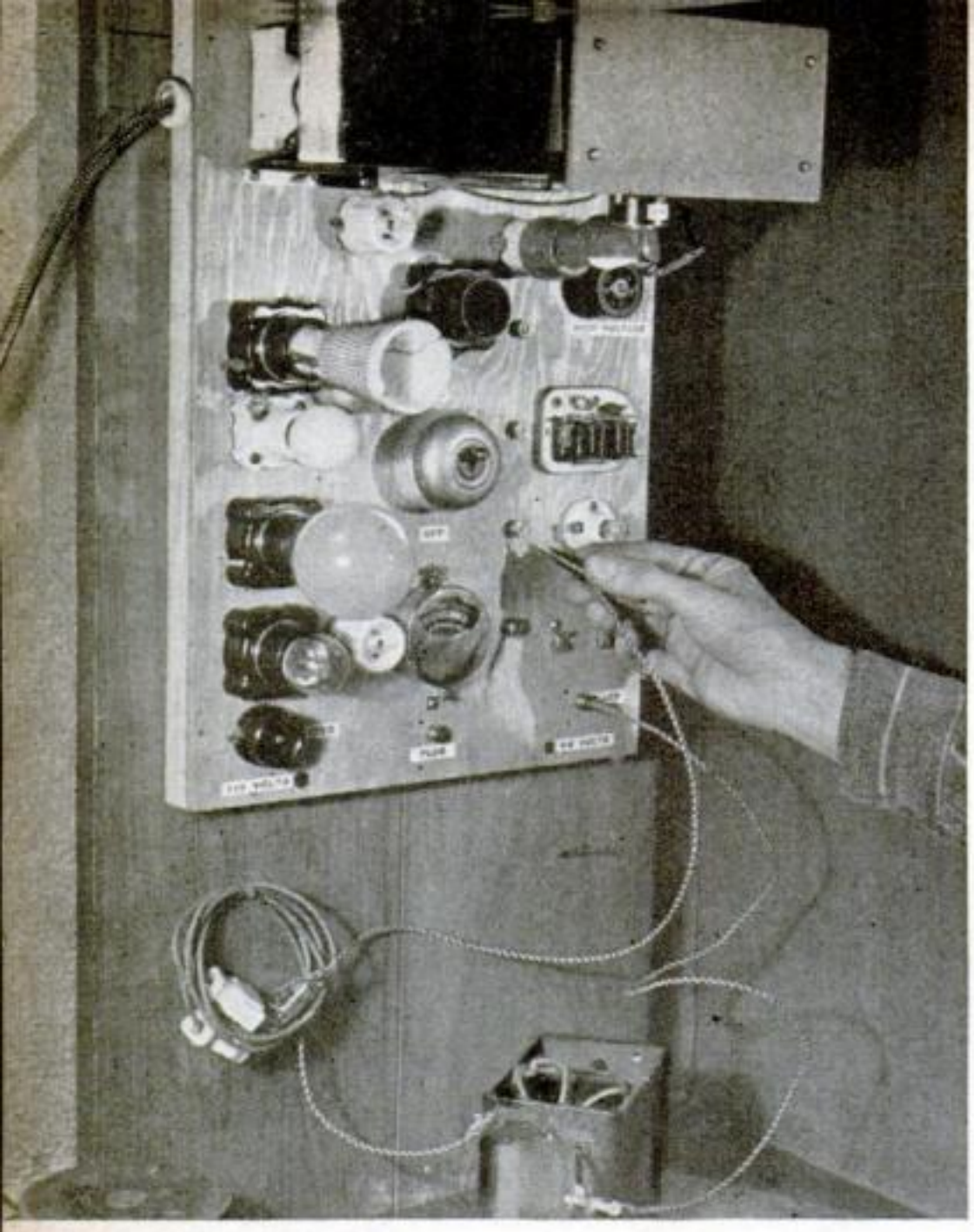
Fig. 3

Electrical Test Panel

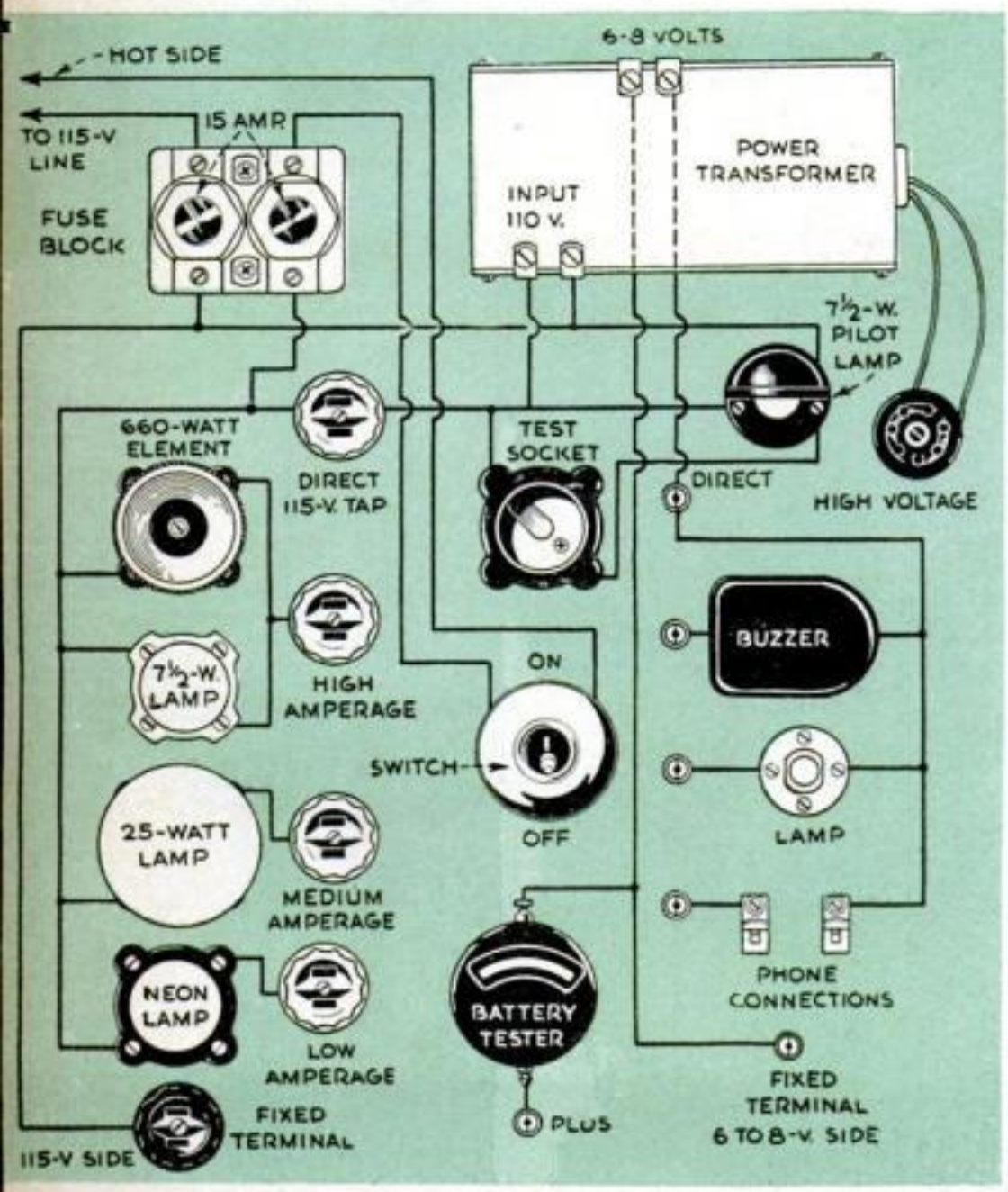
BUILT OF

JUNK-BOX PARTS

By Walter E. Burton



Everything from a toaster to a battery can be tested on this panel. The wiring diagram is shown below



HW 374

With this electrical test panel you can check lamps, motor windings, coils, and the like without having to rummage through boxes and drawers for the necessary equipment.

A piece of ¼" plywood 12" by 17" with strips of wood ¾" square nailed to the back and around the edges to form a frame will serve for the panel proper. At the left side of the layout is the 115-volt testing circuit, and at the top is a fuse block through which current reaches all circuits on the board. A switch, seen near the center of the panel, controls the input current. This should preferably be a double-pole, single-throw switch inserted in both line leads so as to open them when the switch is off. However, a single-pole switch may be used as shown in the wiring diagrams. It is connected to the "hot" or ungrounded side of the 115-volt line, which minimizes the danger of shock when the switch is off. The "hot" side of a house-lighting circuit is the one that will light a lamp when the leads are touched to it and to a "ground" such as a water pipe.

The test-wire terminals or "jacks" are made from small, surface-mounting, single convenience outlets. These are secured to the panel by one screw each. In hooking them into the circuit, connect the wire to *both* terminals. On the end of each test wire of the 115-volt pair, mount a standard two-prong plug, but connect the wire to *one* prong. In this way, the wire will be connected no matter how it may be inserted in the outlet. The other end of each test wire should be provided with a spring clip or with an insulating handle having a pin-shaped contact about ¼" long at the tip.

Above the switch in the center of the panel is a socket for testing light bulbs. Remove the threaded shell from a

surface-mounting socket, place it over a round rod or the tip of a small anvil, and hammer out all the threads. When the socket has been reassembled, a light bulb can be pushed in and removed in an instant. A small night lamp connected in parallel serves as a pilot light and panel illuminator.

A radio power transformer, the secondary taps of which provide a low-voltage circuit, is mounted in the upper right-hand corner of the panel. You can probably obtain up to 20 volts, but 6 volts will suffice for most low-voltage testing. Insert a variable resistance in the secondary leads if the taps give too high a voltage. If you have occasion to use extremely high voltage, you will find that most radio transformers provide anywhere from 400 to 1,200 volts. A multipronged radio connector is used to plug in high-voltage wires. A small toggle switch connected in series with one of the input wires will permit the transformer to be turned off when only the 115-volt side of the panel is being used.

The low-voltage circuit is wired in much the same manner as the 115-volt side in that there are four testing outlets and a fixed or common outlet. Uninsulated phone-cord tip or banana jacks may be used, and the test wires should be equipped with plugs to match. A pair of headphones may be connected for testing radio parts and circuits, photographic flash bulbs, and similar low-amperage devices.

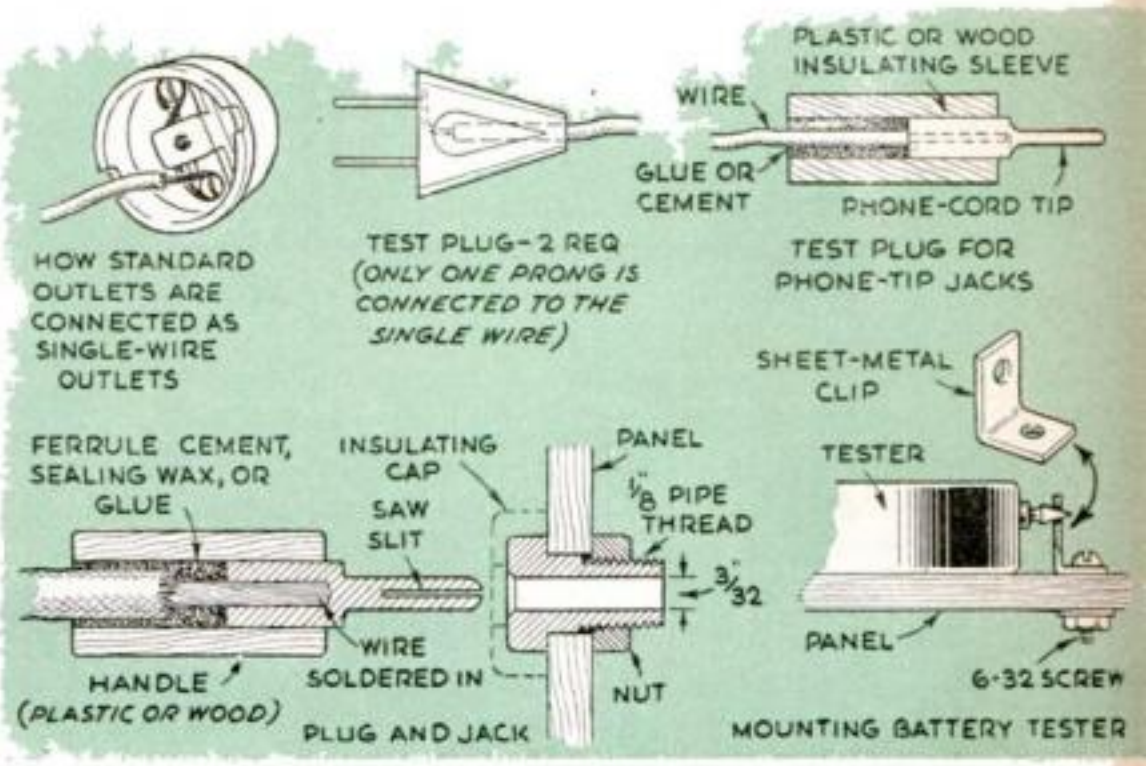
Directly below the main panel switch is a small battery tester of the type used to check the charge of a 6-volt storage battery. The low-voltage test wires are used with this meter, with the main panel switch at the "off" position. Besides serving to check the charge in a battery, this tester also acts as a polarity indicator for checking flashlight cells, auto and radio batteries, and the like.

To illustrate how to use the test panel, let us assume that you have a field coil from an old radio loudspeaker and want to determine whether you can use it on 115 volts as an electromagnet. Plug a test wire into the fixed outlet and clip the other end to one of the coil leads. Clip the other test wire to the remaining coil lead and plug it into the lowest test outlet. The glowing of the neon lamp in the adjacent socket indicates that there is no break in the coil. Now move the test plug to the next outlet. The 25-watt lamp lights, but not to full brilliancy, indicating that the coil offers resistance to the current. Try the next outlet, which is in series with a 660-watt or similar heater element and a small 7½-watt pilot lamp. The heater element gets warm—not hot—indicating that the coil will carry the full 115-volt current without the use of an intermediate resistance. Next, shift the plug to the outlet giving a direct connection to the line. If a small A.C. ammeter is in series with this outlet, you can determine the exact current drain.

If you desire to test some equipment on a very low current, use the glow lamp. Higher currents can be tested with a 25-watt or 100-watt lamp and the 660-watt heater element. When testing for all the amperage the apparatus will draw, use the direct tap.

Flexible lamp cord or No. 14 wire is satisfactory for wiring the test panel, unless the low-voltage side of the transformer has a high amperage, in which case No. 10 or No. 12 wire should be used. The fuse block and exposed transformer terminals should be shielded to prevent accidental contact with live parts, and all portions of the 115-volt circuit and the high-voltage transformer line should be properly insulated.

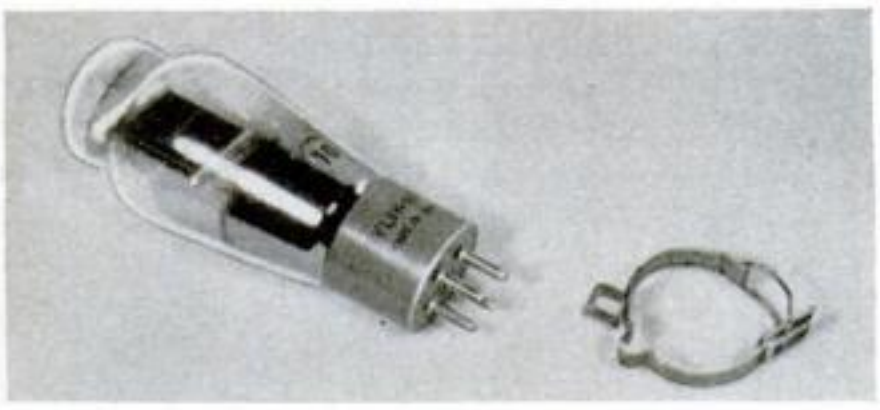
Left below, the high-voltage connection is made through a multipronged speaker connector. In the same photo, the buzzer and lamp of the low-voltage circuit are shown, as well as the threadless lamp-testing socket. The drawings at right show how to mount the battery tester and make various small fittings

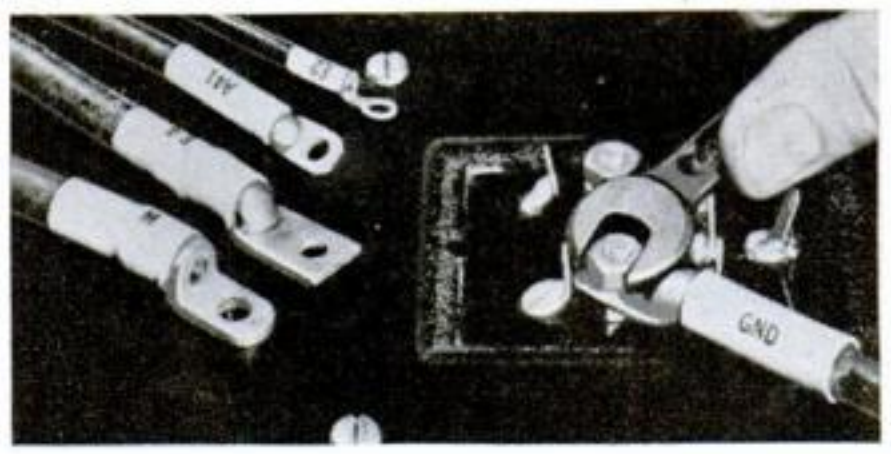


radio ideas

A CATHODE-RAY TUBE has been incorporated into the multitube communicating receiver at the left to give a visual checkup on the characteristics of incoming signals. Placed above the receiver proper, the cathode-ray tube can be switched on any time the operator desires. The image obtained is dependent on the kilocycle width of the intermediate-frequency stages. It enables the operator to adjust the receiver for the best possible reception at all times.

LOCKING CLAMPS for radio tubes, shown below, are in use all around the globe in United Nations aircraft transmitters and receivers. Made of stainless steel, the clamp permits a tube to be removed or replaced instantly, yet prevents it from working loose of itself. Such clamps can be attached to all wafer-type tube sockets and are available in sizes to fit all standard tubes.



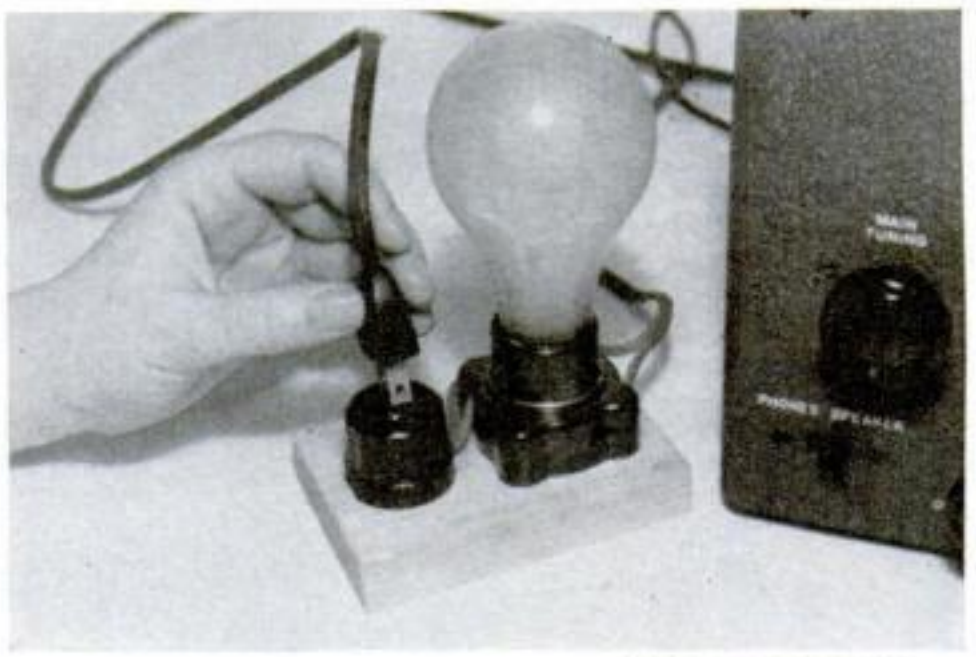


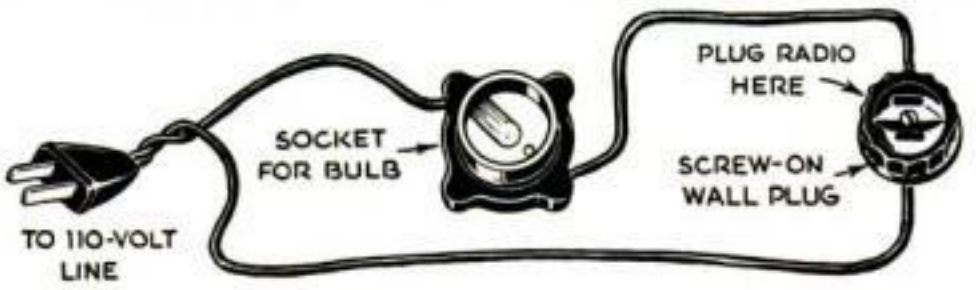
TERMINAL INSULATORS that serve also as wire markers are shown above. They consist of short lengths of extruded plastic tubing marked with appropriate letters and numerals. The material has high dielectric strength, and the markings resist water, chemicals, and oils.

SIMPLE LAMP-BULB RESISTOR LENGTHENS LIFE OF RADIO TUBES

TUBE life can be much prolonged with a simple device consisting of an ordinary lamp bulb connected in series with the line cord of the set. The bulb acts as an auxiliary resistor and decreases the current flowing through the tube heaters. The size of the bulb must be determined by experiment. Select one that allows the set to operate at a little under normal volume. A 100-watt bulb works well with most small A.C.-D.C. sets.

Such a tube saver may be used with either A.C. or A.C.-D.C. receivers containing not more than nine vacuum tubes, but not with radios having 82 or 83 mercury-vapor rectifiers, the operating voltage of which should not be tampered with.—H. B. SMITH.





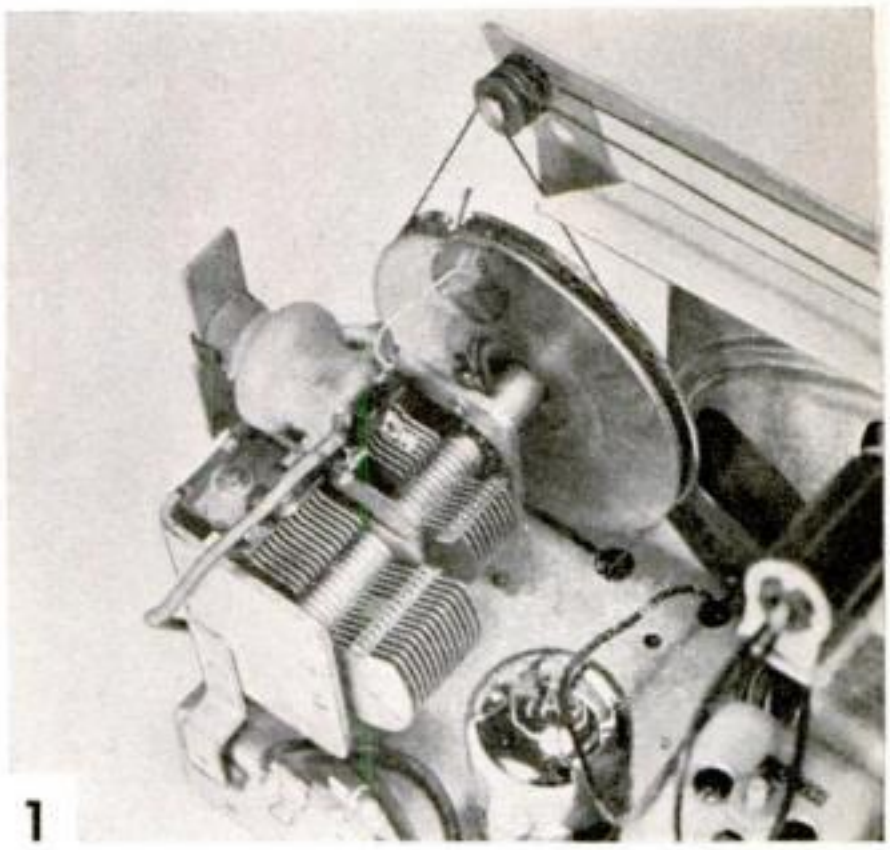
Servicing Your Radio

IT IS possible to realign trimmer condensers on old superheterodynes and T.R.F. sets without the use of a signal generator. A screw driver is the only tool needed.

The only difference in aligning a superheterodyne receiver as compared with a tuned-frequency type is that the former has two intermediate-frequency transformers that have to be adjusted, in addition to the ganged condensers.

Remove the chassis from the cabinet. The photographs show that of a small A.C.-D.C. superheterodyne that will serve as an example. Notice that one of the ganged tuning condensers is smaller than the other (Fig. 1). This is the oscillator tuning condenser and is the harder to adjust. Before touching the trimmers on these condensers, turn the dial to a known station at the high-frequency end (1,500 kc.) and check whether the dial pointer is opposite the correct frequency on the dial. If it is not, adjust the trimmer condenser on top of the oscillator tuning condenser 1/16" at a time by loosening the setscrew as in Fig. 2, thus decreasing the capacity of the trimmer condenser. For example, if the station has been coming in at 1,600 kc. instead of 1,550 kc., by decreasing the capacity of the trimmer the station will be "moved" back to the proper setting. Then readjust the trimmer on the other condenser for the loudest reception. This second condenser tunes the antenna circuit of the superheterodyne.

After the two-gang tuning condenser is aligned, the trimmers on top of the intermediate transformers, which are sunk into the top of the shielding can (Fig. 3), are adjusted either way until the maximum signal reception is obtained. Be careful not to move the setscrews more than 1/16" at a time. Some superheterodynes have padder condensers in the oscillator circuits that have to be adjusted, but in most cases this condenser is fixed.

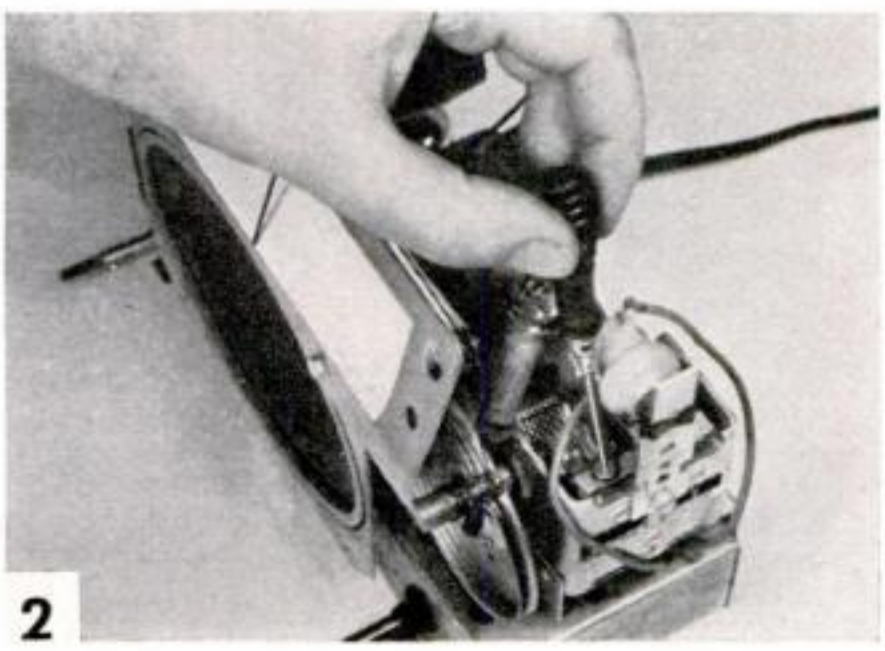


1

Use the same procedure to realign a tuned-frequency receiver. In this case, of course, there is only the two- or three-gang tuning condenser to adjust. The one tuning the R.F. stage is most critical. Turn the setscrew on the trimmer condenser 1/16" at a time and keep the other trimmers in step in the same manner described for the superhet.

It is important to remember that the high-frequency end of the dial (1,500 kc.) must be correctly aligned. Once the stations between 1,250 kc. and 1,600 kc. come in at the proper dial setting, the stations at the lower end will also be correctly aligned on the dial.

With many older receivers it is not always possible to receive stations around 1,500 kc. However, by gradually loosening the setscrew on the trimmer condenser of either the oscillator or radio-frequency tuning condenser, as the case may be, and by keeping the trimmer on the other condenser in line, it is possible to bring in those stations at the high-frequency end of the dial.

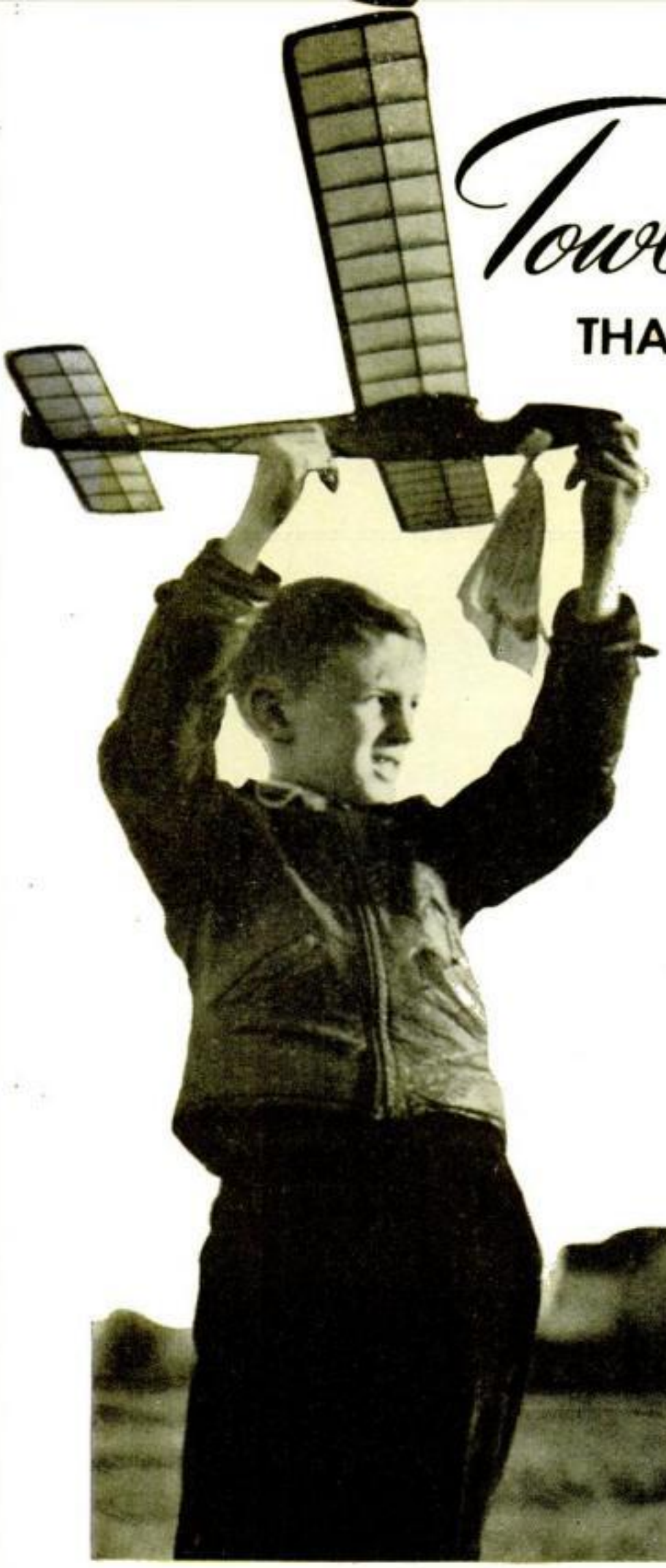


2

3

Towline Glider

THAT YOU CAN BUILD OF PINE



SHORTAGES OF MATERIALS NEED NOT STOP YOU FROM BUILDING THIS ALL-PINE MODEL FOR NEW THRILLS IN MOTORLESS GLIDING

By Frank Zaic

ALTHOUGH the making of model airplanes has been greatly curtailed because of rubber, metal, and balsa shortages, model makers need not despair. A glider is easily built from available supplies, and will afford plenty of excitement.

This towline glider is simple in design and easy to construct. Pine was used throughout in building the model shown, but if balsa is available the same sizes given for pine may be used for ribs, covering, bulkheads, and trailing edges. For other parts, balsa members should be of about double the cross section specified for pine.

Templates for the wing and stabilizer ribs are made first. Do not cut out the spar slot on the template. Instead, prick both the spar outline and the slot through the template on the rib stock. After the rib is cut, the pin marks will serve as guides for cutting the slot.

Before cutting the outline for the front portion of the fuselage, cement the pieces together. Cut the triangular bulkheads individually to the dimensions given. Notice that all are ¼" wide at the top and 1/16" wide at the bottom except No. 1 and No. 2. On a 1/16" by ¼" by 15½" strip, mark bulkhead locations 1⅜" apart. Fix the bulkheads at these points with model cement, making sure that they are all perpendicular.

The assembly should now be pinned to a board so that it will keep its shape while the bottom longeron is cemented to the bulkheads from No. 3 back. Attach the front portion as shown in the drawing. When the cement has set, attach the side longerons. These are straight from front to back. The front portion of the fuselage is covered with 1/32" sheet pine. Leave one lower side (between bulkheads No. 1 and No. 2) open so that the balancing weight can be cemented into this space.

In constructing the wing and stabilizer, draw a full-size view over which to assemble them. It is a good idea to cut the roots of the spars to the correct dihedral angle before assembly. The joint between the center spars is reinforced by two 1/16" by ¼" by 1½" strips as shown. This joint is fur-

Dimensions are based on pine construction. If balsa is used, some members should be larger

33"

1/32 × 1/16 NOTCH

ALL RIBS SPACED 1½"

3/32 × 3/8"

3/32 × 1/4"

2 3/8"

1 5/8"

FRAME OF FUSELAGE

CUT OUT

WING SECTION

FILLET

1/16 × 1/4" STRIPS

PIN PRICKS

STABILIZER SECTION

¼" SQUARES

PAPER GRAIN

RIBS CUT FROM 1/32" PINE SHEET

COLORS:
YELLOW WING AND STABILIZER
RED FUSELAGE AND RUDDER

3½" DIHEDRAL

16½"

1/16" DIHEDRAL BEVEL

WING SPAR (2 REQ.)

STOP STRIP

FORMING DIHEDRAL

SHAPED FROM 3/32 × 3/8" TRAILING EDGE

1/16 × 1/16 × 3/4"

1/16" SQ

1/16 × 1/8"

TOP STRIP

1/16 × 1/4 × 15½"

WING REST 1/16 × 1/4 × 1½"

1/16 × 1/4" INCIDENCE

No 3

ROUND CORNERS

1/16 × 1/4 × 1½"

1/16 × 1/8" STRIP

1¼" 1¾"

3/32 SQ

1/16 × 1/4"

1½"

3/32 × 3/8"

12"

FUSELAGE CONSTRUCTION

TOP STRIP

CUT OUT

ALL BULKHEADS 1/32" THICK

5/8"

1/16 SQ

4"

1/32 SHEET (RUDDER)

5"

11¾"

3 3/8"

1½"

7/16"

15/16"

1/32 PINE SHEET

PIN

3/8"

RUBBER BAND

1/16 × 1/4 × 15½"

1/16 SQ

1 1/16"

C G

TOW HOOK

BALLAST

1 2 3 4 5 6 7 8 9 10 11 12 13 14

1⅝ 1⅝ 1¾ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜ 1⅜

CLOTH OR TISSUE PAPER

CEMENT RIBS ON EACH SIDE OF STRIP TO FORM SELF-CENTERING SLOT

LENGTH OF BULKHEADS					
No.		No.		No.	
3	2 3/8"	7	1 11/16"	11	1"
4	2 9/32"	8	1 15/32"	12	7/8"
5	2 1/8"	9	1 9/32"	13	13/16"
6	1 29/32"	10	1 1/8"		

No.1 No.2

1/16" 7/16" 1" 1 3/32" 3/16" 1 17/32" 1 11/32" 1/16"

1/4" LENGTH 1/16"

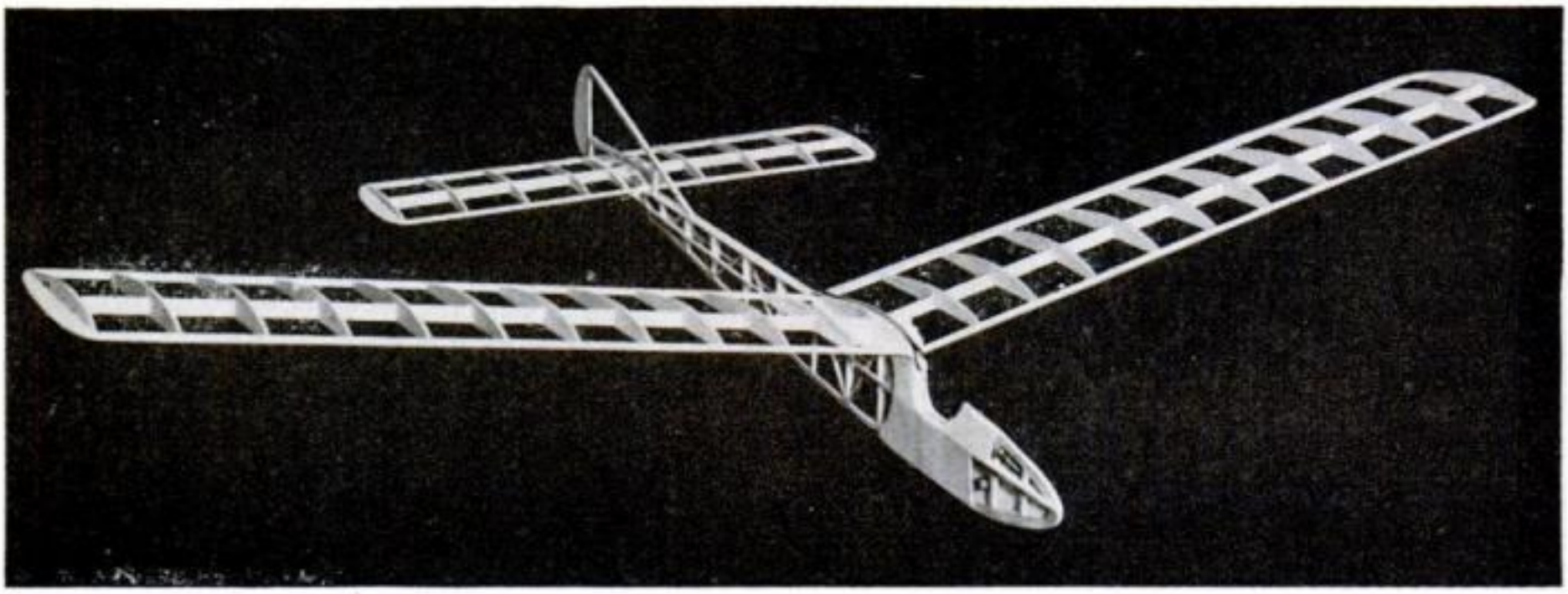
3/4" 3/4" 1⅝ 2 3/8"

WING REST FAIRING 1/32" PINE SHEET

MATERIALS

1 STRIP 1/16 × 1/8 × 36"
2 SHEETS 1/32 × 1¾ × 36"
1 SPAR 3/32 × ¼ × 36"
2 STRIPS 1/16 × ¼ × 36"
2 LEADING EDGES 3/32 × 3/32 × 36"
2 TRAILING EDGES 3/32 × 3/8 × 36"
2 STRIPS 1/16 × 1/16 × 36"
2 SHEETS TISSUE
1 OZ. CLEAR CEMENT
1 OZ. CLEAR DOPE

HW 379



The framework before covering. One side of the nose is left open so that balancing weight may be added

ther secured by a strip 1/16" by ⅛" cemented to the leading and trailing edges and smoothly bent to go over the spar joint. Ribs are cemented to each side of this strip, forming a slot.

The upper fuselage member has a 1/16" by ¼" by 1½" strip mounted on it crosswise, with a similar strip running forward to form the base for the incidence block. The wing is fastened on the fuselage by a rubber band looped from bulkhead No. 6 and hooked under the incidence block. As the rubber band lies in the slot, it automatically centers the wing on the fuselage.

Cover the fuselage, wing, and stabilizer in the usual manner. Use cement-thickened dope for adhesive. Fasten paper only to the spars and longerons of the fuselage. Dampen it to smooth out any wrinkles. Later, apply one or two coats of clear dope over it.

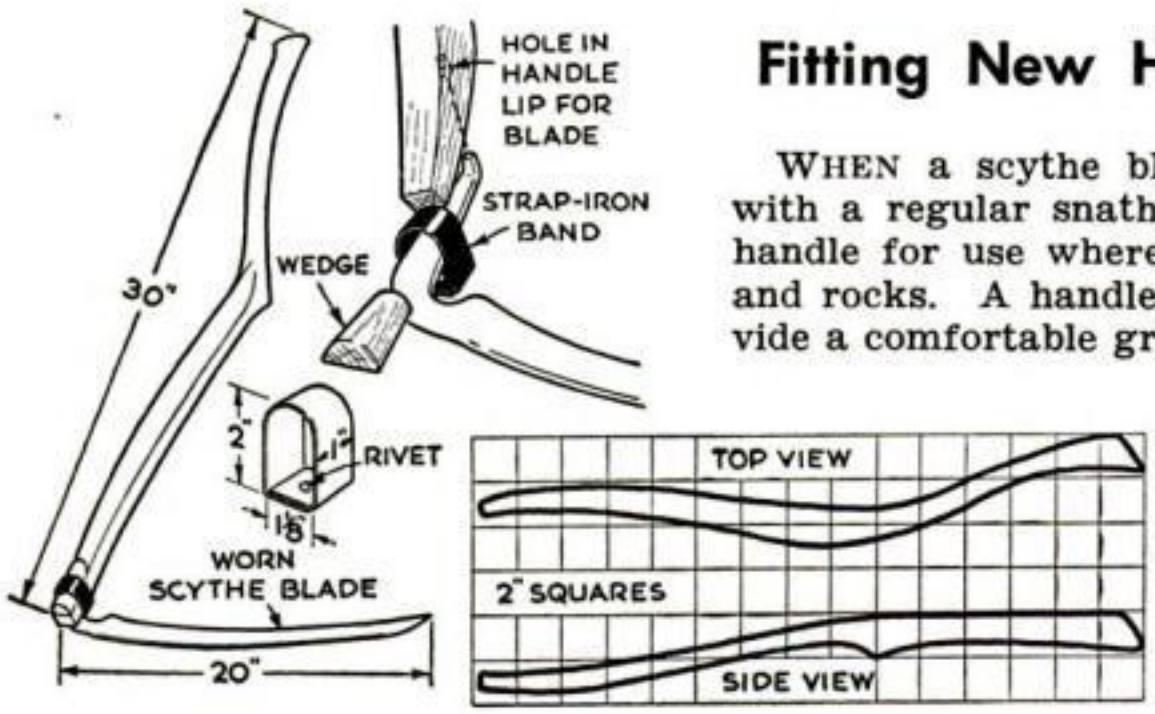
Make the rudder by cutting a 1/32" pine sheet to the outline shown in the drawing and cementing a 1/16" by 1/16" strip to its front. Then fasten both to the fuselage. Form a triangle by adding another strip for the leading edge and add the other straight strips. Complete the framework by bending a strip over the center stabilizer rib. Before covering the rudder, trim the tissue to fit snugly against the stabilizer.

Now the model is ready to be balanced. First fix the wing in place with the rubber band. Then place a sufficient amount of weight in the space between bulkheads No. 1 and No. 2 to balance the model about 1" from the trailing edge of the wing. When the proper balance has been achieved, glue the weight in place, cover with sheet pine, and cover the front of the fuselage with paper and dope. Cement the tow hook under bulkhead No. 3.

To fly the model, glide it into the wind and note whether it dives or stalls. Add weight in the form of clay accordingly. Note the shape of the tow ring and how closely the pull-off tissue is tied to it. Be sure the tow is straight into the wind, as indicated when the sag of the line is straight down. It is best to note the natural turn of the model before making any adjustments on the rudder.

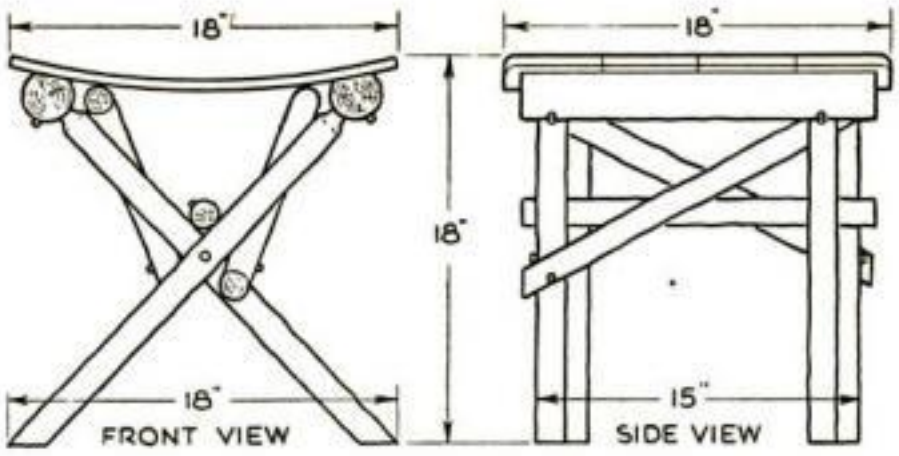
This model is not eligible for contest flying, since the fuselage lacks the required cross-sectional area and the wing loading is too low, but it might, if desired, be built with a larger, heavier fuselage.

Fitting New Handle to Worn Scythe

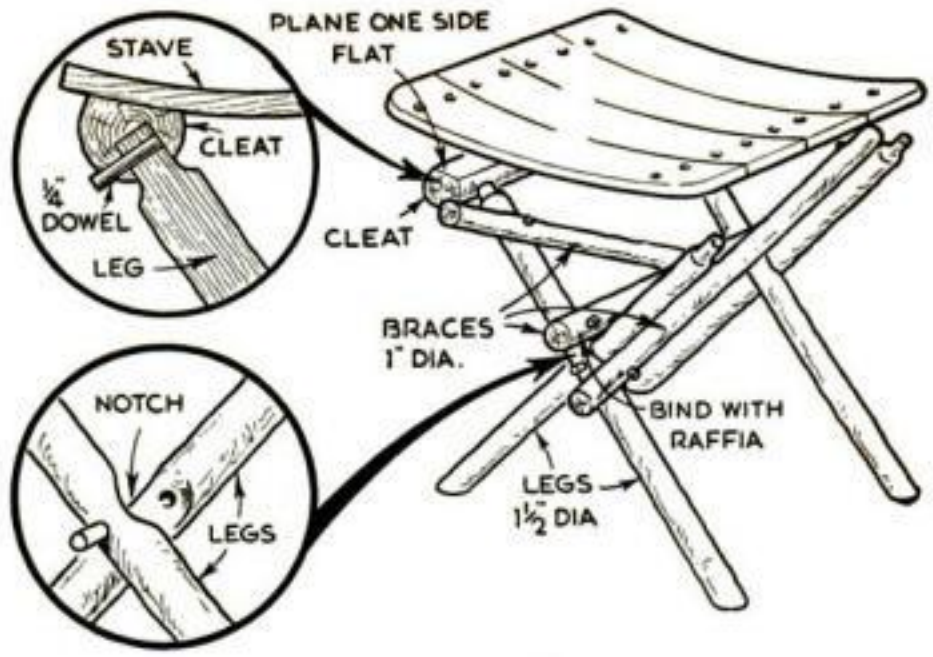


WHEN a scythe blade has worn too short for use with a regular snath, it can be attached to a shorter handle for use where the swing is restricted by trees and rocks. A handle cut to the shape shown will provide a comfortable grip. A healthy tree branch approximating the desired shape will form a stronger handle than one cut from a straight-grained piece. Such limbs can be found on many kinds of trees, but birches and maples will provide the most satisfactory handles of this type.—J. MODROCH.

HW 380



OUTDOOR FURNITURE constructed of rough materials always harmonizes well with the natural setting of a garden or lawn. This stool made of saplings has a curved seat of old barrel staves. Trim, fit, and dress the staves as shown in the drawing, being sure to smooth any splintery edges. Countersunk screws hold the seat to two cleats made of saplings planed smooth on their top sides. The cleats are bored to take the shaped ends of the legs, and ¼" dowels through the cleats into the ends of the legs secure the joints.



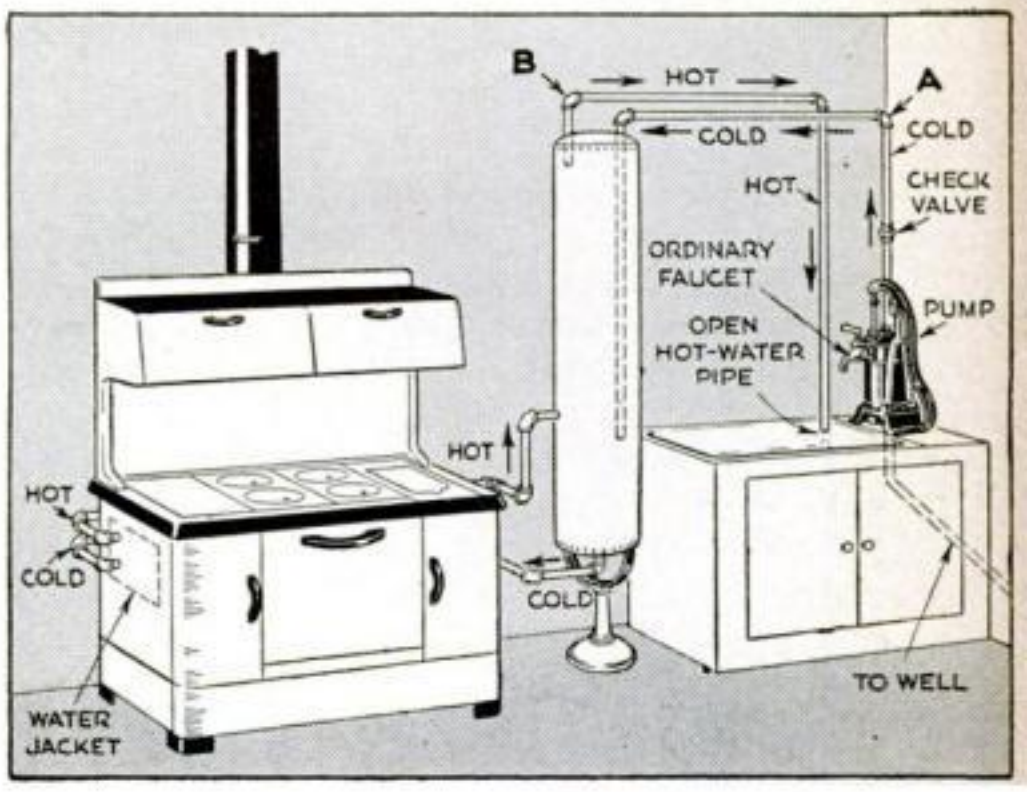
All bracing joints are also doweled, with one end of the dowels protruding as pegs. Where braces and legs cross, they are slightly notched to make for sturdiness. Binding the end joints of the straight brace with raffia will add strength and a touch of rustic craftsmanship.

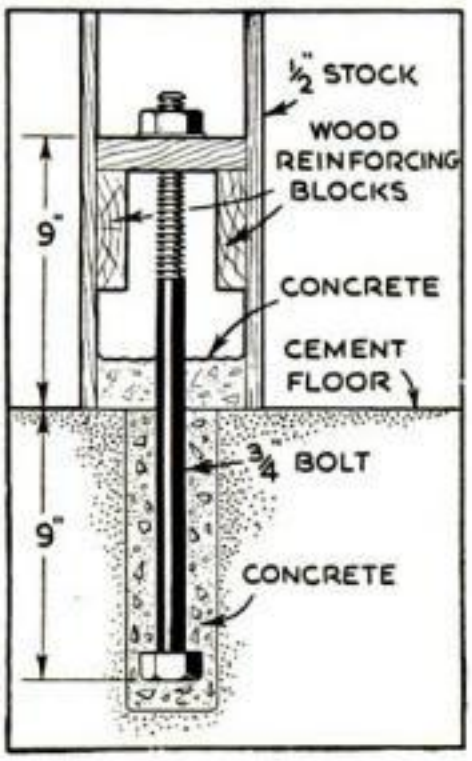
The stool has no finishing of any kind, in keeping with its character. If desired, a set of these can be made for barbecue parties or back-yard picnics.—HI SIBLEY.

A HOT-WATER SYSTEM for farm kitchens without running water can be made of standard parts as shown at the right.

The force pump should be the type having an extra discharge outlet in addition to the spout. When the faucet on the spout is turned on, cold water can be pumped directly from the cistern. When this faucet is turned off, however, and the pump is worked, water goes up through pipe *A* and into the bottom portion of the hot-water tank. In so doing, it displaces hot water from the top of the tank. This water is forced through pipe *B* until it comes out directly over the sink. A hot-water jacket in the kitchen range is connected to the boiler in the usual way.

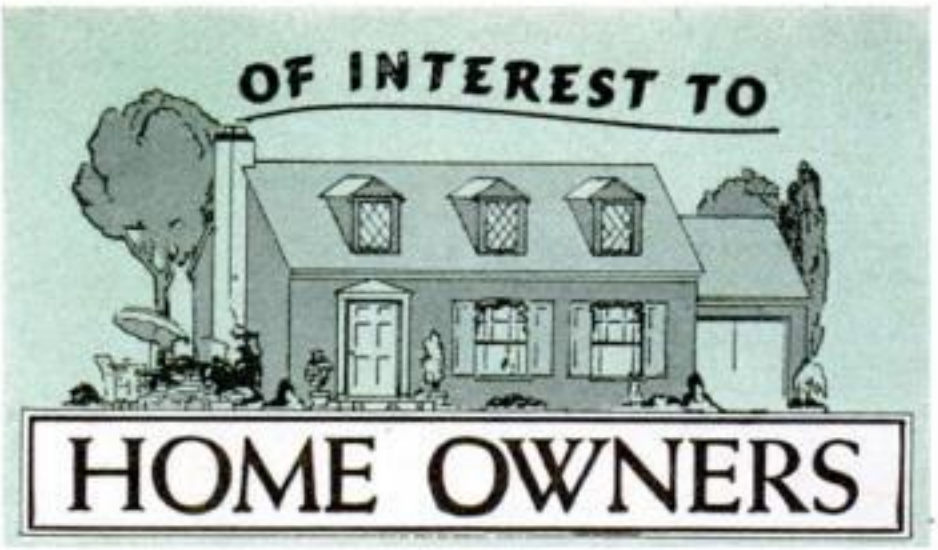
It must be remembered that no hot water is obtained unless the faucet is closed and the pump worked. The range boiler is in no danger of running dry if the pump is not used, for no hot water leaves it unless the pump is worked. The only other outlet from which water can be drawn is the drain at the bottom of the tank, which is used only when it is necessary to clean it out.—JOSEPH W. REIS.



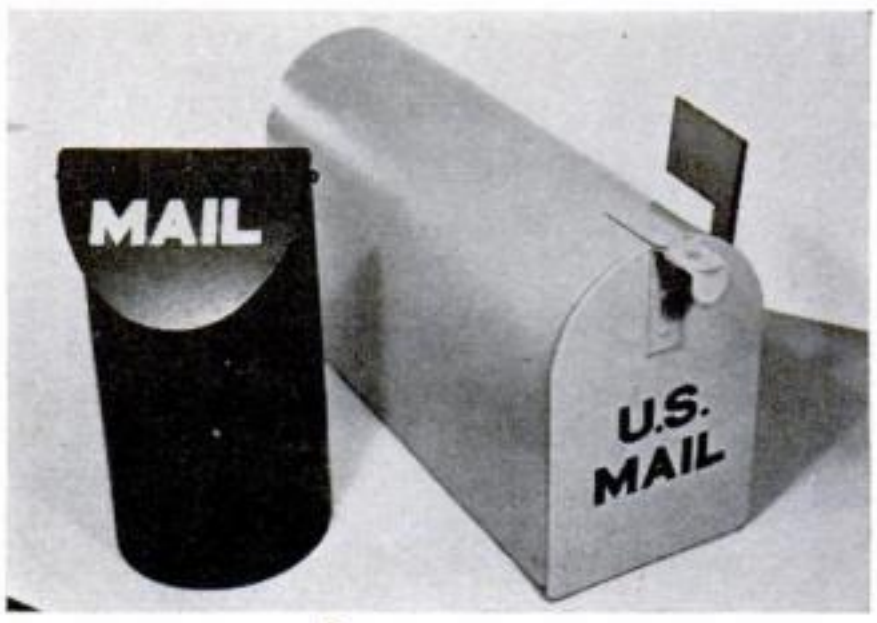


SECURING A HOLLOW POST to a cement floor presented a problem which my carpenter solved ingeniously.

He first chiseled a hole about 10" deep in the cement, and inserted a ¾" bolt around which he poured concrete. Next, he constructed three sides of the post, leaving the front open. A square of ¾" stock with a hole in the middle for the bolt was butted on top of two reinforcing blocks and nailed to them and to the side boards of the post. After the cement had hardened around the lower part of the bolt, the nut was drawn up tight. Cement was poured around the bolt at floor level, and the front board of the post was then nailed in place. The result was a newel at the foot of the stairs strong enough to stand all stresses.—PAUL B. MANN.



NEW MAIL BOXES made of plastic with a wood-fiber base, which is a noncritical material, are now available for house or R.F.D. use. The boxes are finished with a paint durable enough to withstand the most severe exposure out of doors. Both the porch and R.F.D. types are shown in the photograph below.



OUTSIDE WINDOW FRAMES with interchangeable glass panes and screen panels can be permanently installed outside of ordinary sash. Glazed upper and lower sashes are provided with each unit, along with a screen to be used in summer in place of the lower sash. Both glass and screen sections are attached to the frame on the inside with clips that can be fastened or released in a matter of seconds. All parts are removable for cleaning.

VERSATILE WAX. Besides serving all ordinary household purposes, this wax can be used to waterproof rope, awnings, tents, sails, and the like. It also forms a rust-preventive coating on machinery, firearms, tools, fishing tackle, and other metal articles. It is said to prevent cracking and drying out of leather articles, and can be used as a dressing on luggage, boots and shoes, belts, harness, handbags, wallets, and leather upholstery.

THIS INSECTICIDE is applied to screens and kills moths, gnats, mosquitoes, and flies. The solution comes complete with applicator. It is brushed on the inside surface of the screens and is said to last four to seven days. Insects endeavoring to get through the screen are paralyzed. Flies and mosquitoes inside the house are naturally attracted sometime during the day to the light coming through window openings and receive their lethal dose at that time.

FIBER RECEPTACLES like that shown at the left may replace metal garbage and trash cans, the manufacture of which has been curtailed by the war. According to the maker, these new lightweight containers made of asphalt-impregnated fiber have a bursting strength of 500 lb. per square inch. They are water resistant and vermin-proof and have a capacity of 20 gal. Sturdily made, these receptacles are suitable for either outdoor or indoor use.

"PACKAGES" FOR PAINT. Since the new glass paint containers do not have wire handles, a special paper container with paper handles has been devised for carrying them on the job. These bags are made of extremely tough paper and are of convenient size for carrying glass paint jars that hold up to 1 gal.

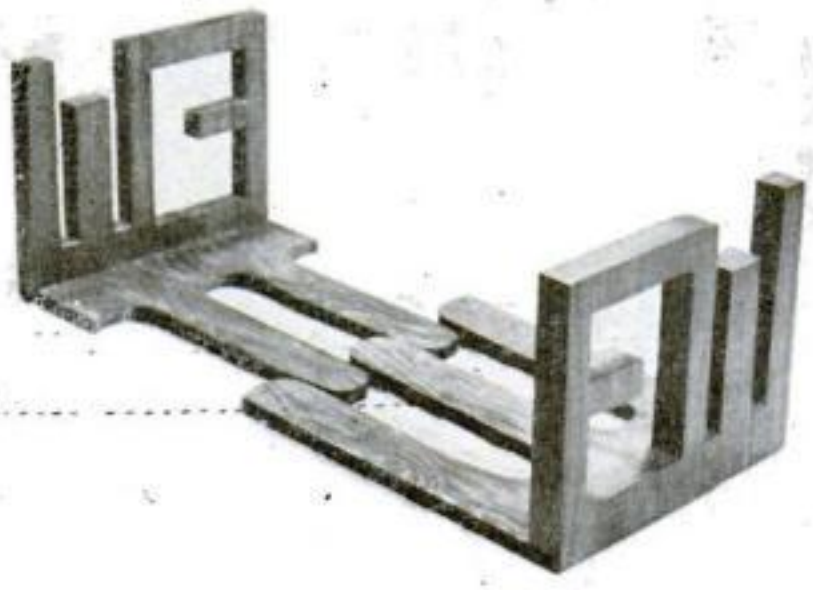
SCREEN PAINTING has been simplified by a new applicator (not shown) which is used by rubbing it on the screen like a blackboard eraser. A special paint-retaining fabric on the applicator covers the wire mesh yet does not clog the spaces as so often occurs when an ordinary brush is used.

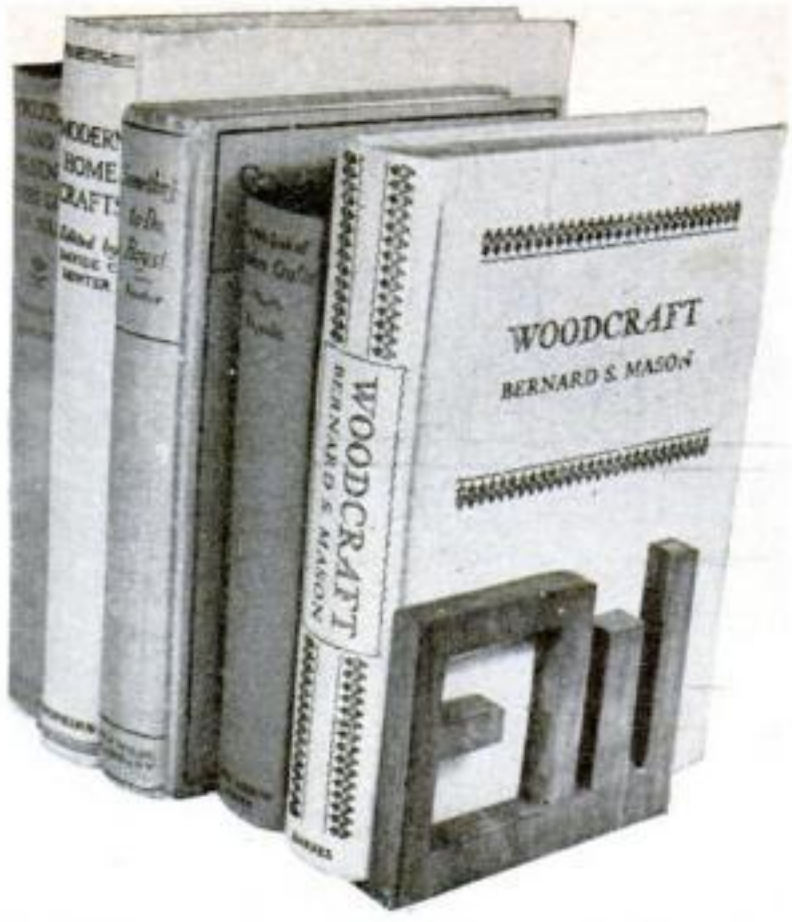
PREPASTED WALLPAPER can be applied without the professional help that is usually necessary for ordinary paper hanging. Created primarily to enable the home owner to redecorate his own walls, it is sold in packages with matching borders. No special tools are needed to apply the paper, which comes in attractive designs and colors. Each package contains an 81′ roll of wallpaper and 16½′ of border.

Put the rolled strip in water and reroll it so that the adhesive will become thoroughly wet. Cold or at least cool water should be used

Unroll about a foot of paper and smooth it out with the flat of a hand to work out air bubbles as you continue down to the baseboard. Trim the end with a razor blade

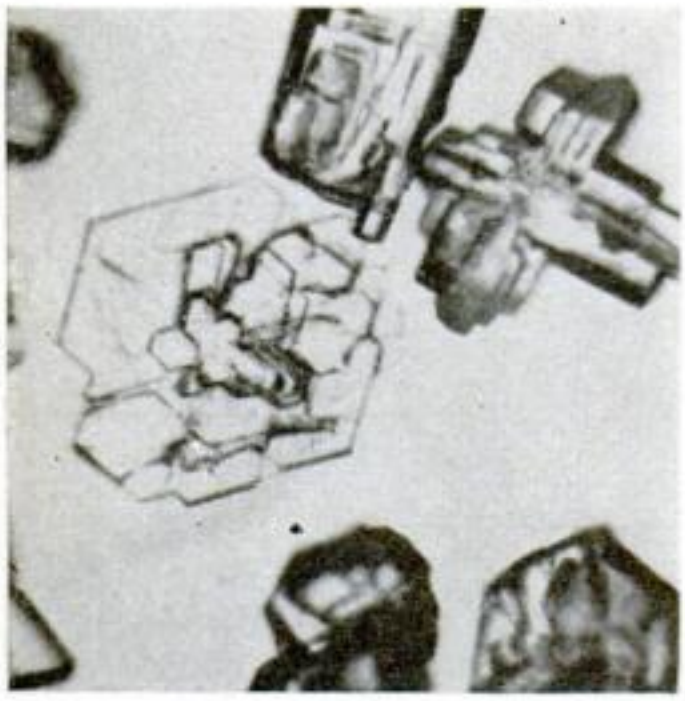
Wooden Initial Book Ends Are Adjustable and Nontipping





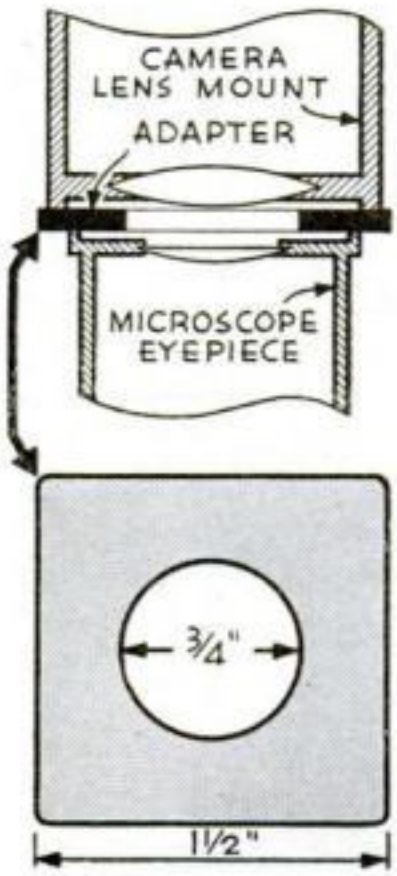
BY USING a wood for the initial ends that will take an attractive finish, and thin plywood for the fingered bases, very satisfactory book ends can be made similar to the pair shown in use above. They are adjustable as to length, and the base prevents them from toppling over.

Lay out two initials on a 4" by 5" sheet of paper, or three initials on a piece 4" by 7½". Paste the paper to the endpieces and cut out the initials on a jig saw. Rabbet the bottom edge of each end to receive the plywood bases. Secure these with flathead screws countersunk in the plywood.—ELMA WALTNER.



Boric acid crystals photographed with an ordinary camera and a microscope

Adapter for Photomicrographs

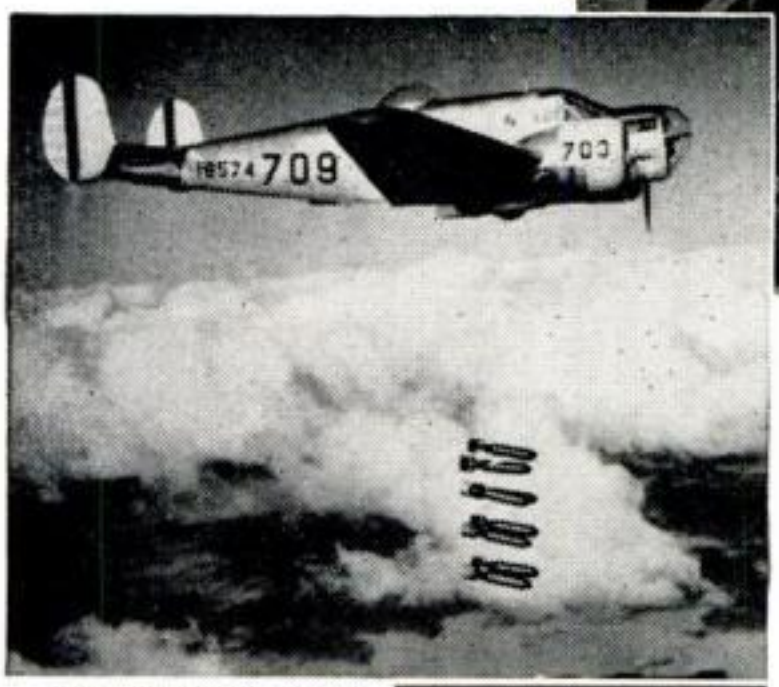


Sheet metal, plastic, or composition board with one ¾" hole drilled or reamed in it forms the adapter plate

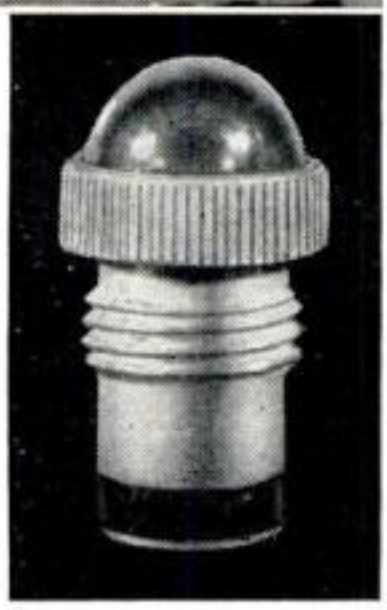
MICROSCOPE specimens can be easily photographed with a small camera by the use of an adapter that supports it on the microscope eyepiece.

Cut a 1¼" square piece of 3/64" thick sheet metal, plastic, or hard composition board and drill or ream a ¾" hole in it. Roughen the surface of the adapter with emery cloth to prevent the camera from slipping. With proper lighting on the subject, care being taken to avoid reflections that might reach the lens, good pictures are possible without the elaborate equipment usually necessary. To check the focus, lay ground glass over the film track.—ROBERT GOLBY.

Out of a G-E engineer's home workshop . . .



Bomb indicator lamps (shown twice actual size at the right) on the instrument panels of this AT-11 Beechcraft Bombing Trainer tell the bombardier how many bombs have been released and how many remain.



FREE! 20-page booklet "How Light Can Help You Speed Victory," shows why poor lighting slows production, tells how to improve it. Write General Electric Company, Dept. 166-P8-8, Nela Park, Cleveland, Ohio.

THE Army asked General Electric for a tiny lamp to signal "bombs away." A lamp that would produce a light of a distinctive color. Idea for the solution came to a G-E engineer when he noticed the translucent plastic handle of a kitchen paring knife on a workbench in his attic workshop. Cutting off the tip of the handle, he produced a dome-shaped, colored plastic cap, which he fitted over the tiny G-E grain-of-wheat bulb used in surgical instruments. This lamp, after weeks of intensive experiment in G-E laboratories, served as the model for the thousands of bomb indicator lamps now in use on U. S. bombers.

ONE OF 150 SPECIAL LAMPS. This is only one of more than 150 G-E lamps that have been developed to meet specific military needs since the war started, and one of hundreds of types of special lamps G-E is making for military service. These include everything from lamps for submarines and battleships to those in tanks, jeeps, and aircraft.

ONLY PART OF THE JOB. Making special lamps for the armed forces is only one of G-E's wartime lighting jobs. Eliminating glare, gloom, and shadows in war plants, big and small, is another. Your nearest G-E lamp office, your G-E lamp supplier, or your electric service company will gladly supply helpful advice to any war plant.

G-E MAZDA LAMPS

GENERAL ELECTRIC

Tune in the G-E MAZDA lamp radio program Sunday at 10 p.m. (Eastern War Time) N.B.C.

Balloon Juice

(Continued from page 90)

larged by only a few inches in diameter and filled with 2,850 cubic feet of helium to accomplish the same end. Since helium has the enormous advantage of being fireproof, preference for its use extends even to balloons that do not carry men.

The Weather Bureau sends up several sizes of helium balloons. By following the ascent of tiny 1½-cubic-foot balloons, meteorologists can gauge ceiling altitude; larger pilot balloons, with a capacity of five to 32 cubic feet, serve as straws in the wind to measure direction and velocity; still larger ones carry radiosondes that broadcast readings of temperature, humidity, and air pressure.

Helium fills our "air whales," or barrage balloons, whose webs of steel mooring cables serve to keep bombers high above cities and ships. These range from the giant Strato-Sentinel that rises three miles to smaller types that are towed at several thousand feet by ships and trucks. Observation balloons are smaller. Both types may use hydrogen, if they are not near strategic centers where safety is imperative, but its use requires extreme precaution against fire. To make helium go further, it has sometimes been diluted with 15 per cent hydrogen, forming a mixture that is not combustible in air.

Navy blimps, filled with helium, have proved excellent scouts. They can survey an area from every angle, minutely and leisurely. Because their lifting power does not depend upon motion, they can hover over suspected submarine hideouts and release depth charges. They are dependable, too, for only a zero ceiling keeps them grounded. Today, Navy blimps are doing essential patrolling on the East Coast, helping to keep down the U-boat toll.

Our airships owe more than their fire insurance to the use of helium—greater speed, for instance. The passenger and motor-carrying "basket" or gondola is now suspended from the inside of the balloon, while the hydrogen ship hung it for safety from the outside, where cables increased wind resistance and cut down speed. Helium is more convenient than hydrogen, too. It does not readily filter out through the ballonets. While hydrogen becomes so aerated that it must be replaced after a year's use, helium keeps pure for several years and is easily and cheaply purified by condensing off the nitrogen and oxygen. Over a period of years, this helps compensate for helium's high initial cost.

Life Guards —FOR BOMBER CREWS —FOR YOUR ENGINE

OXYGEN PRESSURE GAUGE—built by AC

AUTOMOTIVE SPARK PLUG

IN THE THIN SUB-STRATOSPHERE, fighter pilots and bomber crews need extra oxygen to live. And they *must* know when the supply is running low. So, AC builds pressure gauges for each oxygen supply cylinder.

Those gauges must not only be accurate—they must be absolutely dry, and must *stay* dry, or an oxidizing "explosion" will burst every lung, instantly.

To build such vital devices requires foolproof, precision manufacturing. Thus, AC's long experience in producing millions of peacetime Spark Plugs, Oil Filters, Fuel Pumps, Speedometers, and instruments comes into full play for war.

For Your Engine

But, no matter how well a device is made, it must be *kept* in good condition. This is also true of your spark plugs. Dirty spark plugs waste gas, cause hard starting, and rob your engine of power. They should be cleaned and adjusted—*regularly.*

Through its Conservation Service, *any* repair shop—*anywhere*—can do this for you. Such shops can also give quick, expert service on the eight other AC products in use on many millions of vehicles. If you wish to know what care *yours* should have, read the brief story below. Then, to conserve the life of your vehicle,—and gasoline, oil, and tires as well,—follow the suggestions given there. When replacement becomes necessary, select AC—and be sure of complete satisfaction.

Awarded to the men and women of AC on September 2, 1942, for outstanding achievement in producing for Victory.

AC SPARK PLUG DIVISION
GENERAL MOTORS CORPORATION

SPARK PLUGS—Dirty or worn plugs waste as much gas as one coupon in ten. Oxide coating collects on the plugs and causes them to misfire,—especially when the engine is working hard. Dirty plugs also cause hard starting which weakens your battery. Under present slow driving conditions, have your plugs cleaned and adjusted every few months.

AIR CLEANERS—A dirty air cleaner increases gasoline consumption because it chokes down the flow of air into the carburetor. Your air cleaner should be rinsed whenever your car is lubricated.

FUEL PUMPS—Practically trouble free. But, if yours has been in use thirty or forty thousand miles, it may be worn to the point where a check-up is due.

DRIVING INSTRUMENTS—Speedometer, gasoline gauge, oil pressure gauge, ammeter, and temperature gauge seldom need service. But, if they give trouble, have them cared for *at once.*

OIL FILTERS—Slow driving accelerates formation of soot and carbon in engine oil. If not constantly filtered from the oil, this dirt will clog piston rings, cause increased consumption of oil and gas. So, replace your oil filter element whenever your dealer's AC Oil Test Pad shows that your oil is dirty.

BRING VICTORY QUICKER—BUY U. S. WAR SAVINGS STAMPS AND BONDS

Tojo Meets a Wildcat

(Continued from page 100)

September 12 through October 15, Fighter Squadron Five downed five, four, eight, four, ten, three, one, three, five, and two enemy planes, as daily scores, besides six 'probables.' The squadron was then evacuated by ship and plane for a much-needed rest. Only four of its planes had been destroyed by enemy action in the air, while based on Guadalcanal. During the evacuation by ship we mourned the loss of five of our men as a result of enemy bombing attack."

Among the high scorers of the squadron in planes shot down were Lieut. H. M. Jensen, of St. Paul, Minn., with seven bombers to his credit; Lieut. C. B. Starkes, Junction City, Kans., five bombers and a fighter; Lieut. F. R. Register, Bismarck, N. D., one bomber and four fighters; and Lieut. J. M. Wesolowski, Detroit, Mich., four bombers and a fighter. Twenty-seven other members of the squadron brought down at least one foe or more. They were all in there fighting, and, as Commander Simpler remembers, "fighting as a team."

Such is the record of the men who fly the Navy's Wildcat. There are more than 20,000 persons engaged in making either this fighter, or other Grumman planes for the Navy at more than 12 plants scattered about Long Island, N. Y., and more than one in five of the workers is a woman. Production of the Wildcat is now being shared by the Eastern Aircraft Division of the General Motors Corporation. Three men are the leaders in the process of manufacture—Leroy A. Grumman, president and chairman; Leon A. Swirbul, executive vice president; and William T. Schwendler, chief engineer. Grumman was in the Navy in World War I, Swirbul in the Marine Corps. They organized the company in 1929 with a capital of $32,000, of which $15,000 was borrowed. As the result of building the finest fighting and torpedo bombing planes for the American Navy, this company increased its gross sales of these weapons from $4,482,350 in 1939 to $143,155,930.81 in 1942, producing planes often with no buildings to house parts of manufacture, and subcontracting to hundreds of other manufacturers.

For their success in manufacture they give credit primarily to "thousands of willing hands," now working along the assembly lines, while success in battle comes from the stout hearts and well-trained flying of Navy airmen, such as Fighter Squadron Five. Planes and men such as these have given Tojo something to think about.

BOMB HITS CROWDED ENGLISH HALL—GAS PERILS RESCUERS...

A true experience of Frederick Mockford, Incident Officer, Deptford District Civil Defense, London...as cablegrammed by a war correspondent.

DISTRICT POST INFORMED ME HIGH EXPLOSIVE BOMB HIT JUST BEFORE CLOSING TIME. BOMB WENT THROUGH BILLIARD ROOM, CARRYING TABLES CLEAR DOWN TO CELLAR.

I GOT MY SQUAD ON SPOT WITHIN FEW MINUTES. ESCAPING COAL GAS OVERCAME SEVERAL RESCUERS AND MADE FLASHLIGHT SAFEST AVAILABLE LIGHT. RESCUE PARTY WORKED THROUGH NIGHT UNTIL DAYLIGHT, BOMBS CONTINUING TO ROCK BUILDING

I SENT SOS CALL FOR BATTERIES. THANKS TO FACT FRESH ONES WERE AVAILABLE FOR JUST SUCH EMERGENCY WE WERE INSTRUMENTAL SAVING LIVES AT LEAST 15 PEOPLE.

Keep your batteries ready for emergencies!

Mr. Mockford's experience—like many such others that have come out of England—is typical of the many emergencies that call for the use of a flashlight. Any kind of open flame would have ignited the coal gas, blocking attempts at rescue.

For your own protection, as well as to conserve materials vitally needed elsewhere in this war, follow the suggestions and instructions of your local Defense Council. Reduce the use of your flashlight to a minimum. Make the batteries last longer!

Steel Doubles for Brass

(Continued from page 126)

found that deep-drawing of cold steel could be done. Right now they draw to a ratio of seven or eight to one, and Patterson says the only limit he can see is the depth capacity of the big punch presses which drive down on the metal.

Then all he had to do was to go back and find some way to build into the steel cases the necessary physical properties of the brass case. Until then he had been comparatively free to experiment with different types of steel. Now he learned that high-alloy steels were definitely out—the Army was short of chrome and nickel, too. The type they finally settled on is a medium commercial steel—a little better than what you would put in an automobile's fenders, but not quite as high in carbon as bumper stock.

In the next few months the phrase "physical properties" became something between a prayer and a malediction in Patterson's mind.

The problem was to induce the proper physical characteristics in a steel case by a process of cold-drawing. You draw steel by placing the part in a die, and then coming down on it with a tool-steel plunger, driven at perhaps 40 tons' pressure by a hydraulic or mechanical press. Drawing elongates the steel, forces it to the desired shape, and also hardens its structure, which is desirable up to a point.

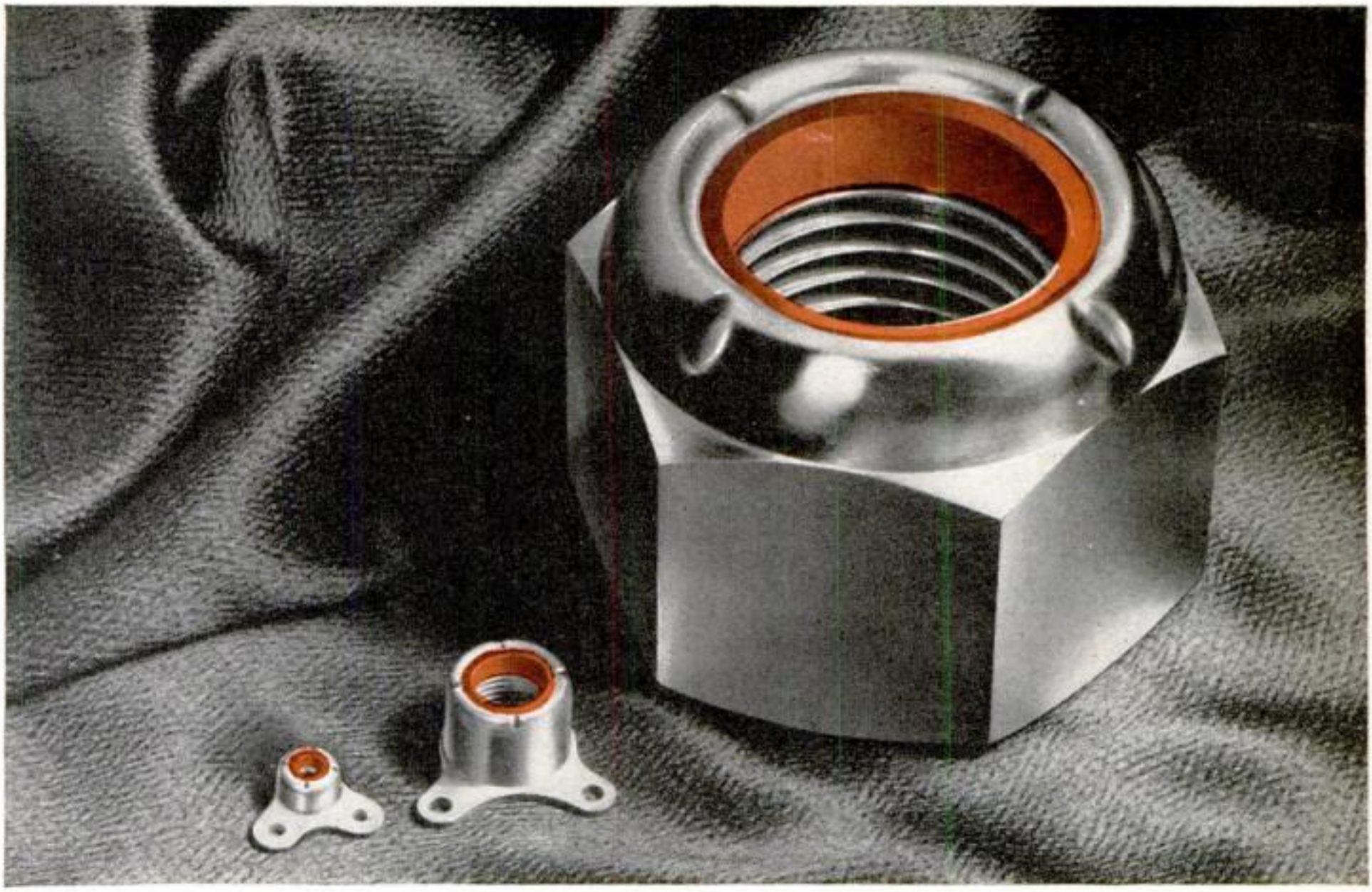
That point is reached when the steel has become so hard as to be brittle, and likely to crack during the next draw. This difficulty had to be solved experimentally by alternating the cold draws with periods of annealing, in which the parts are heat-treated under conditions of exact time, temperature, and atmosphere control. The annealing, in effect, softens the body of the steel and enables it to undergo another hardening draw.

Within a few weeks Corcoran-Brown had sample shell cases that would eject as well as fire. But samples are not the same as mass production, and some weary months were spent before the complex problems of large-scale manufacture of completely reliable cases could be solved.

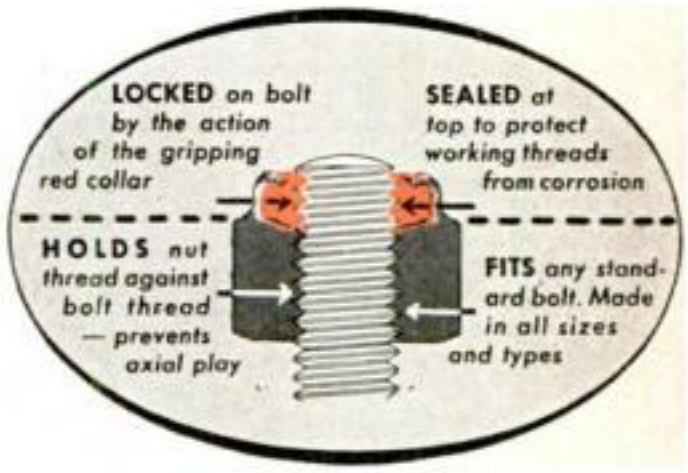
What the Army has now is a perfectly satisfactory steel shell case that can be made in any size from the 20-mm. automatic cannon to the standard 105-mm. gun-howitzer. Steel cartridge cases for small-arms ammunition are in the experimental stage.

Technical data on the process is restricted, but it is possible now to describe the method in general terms. The shell case starts as a

(Continued on page 208)



THE REASON FOR A NUT



• There's only one reason for a nut.

That is to hold things together.

To make a nut that does this isn't as simple as it sounds.

But here is a nut that goes on and locks – all by itself – wherever you want it.

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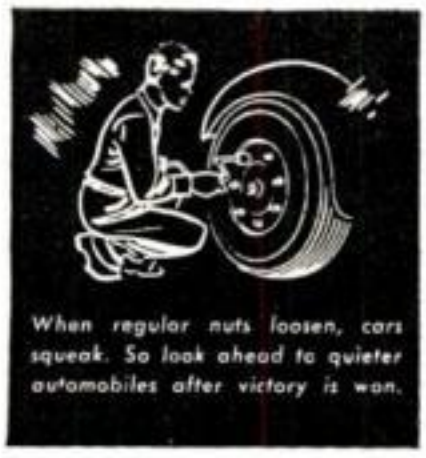

When regular nuts loosen, cars squeak. So look ahead to quieter automobiles after victory is won.

On a lawn mower, ordinary nuts may loosen, fall off, get lost in deep grass. Elastic Stop Nuts stay put.

Washing machines call for nut-and-bolt connections that stay tight under heavy use. Elastic Stop Nuts keep such appliances running right

Steel Doubles for Brass

(Continued from page 206)

steel blank, a disk of given size and weight, cut from sheet stock. From the blank a cup is forced under pressure.

The cup is annealed, then submitted to the first draw, which elongates it somewhat and gives it cylindrical form. Then the piece must be washed, annealed again, and coated with a soapy solution which acts as a lubricant and protects the die during the second draw. The process of annealing is repeated before the third and fourth draws. During annealing, the pieces are piled in a metal basket and sent along a roller conveyor through a rigidly controlled gas furnace. The annealing heat applied is around 1,300 degrees F., and the full cycle of heating and cooling takes an hour and a half.

After the drawing is complete, the case is washed and rough-trimmed, then put through a series of machining operations which cut, drill, and polish the head, and taper the mouth where the projectile eventually will be crimped in. Both these operations require unusual precision and are performed on automatic machines. The New Britain–Gridley machine that handles the heading process performs nine operations on the case of a 20-mm. shell while cutting and finishing the primer hole and the groove at the base, which will be engaged by the gun's loading and extracting mechanisms.

Steel cases must have a coating of some kind to prevent rust or corrosion, and also to lessen the chance of striking sparks if a case is banged against some other metal. At first it was possible to use copper-clad steel for the blank, or to plate a thin film of copper on the shell. The growing copper shortage soon ended that, however, and now the shells must be coated with a phenolic varnish, which is baked on. It turned out that, after the dipping, excess varnish had a way of gathering in a bead at the mouth of the shell. Now they pass on overhead conveyors over a "detearing plate," in which a current of 130,000 volts sets up a powerful electric field and pulls the bead of varnish off in a fine spray.

Although he has his production to keep up, "Pat" Patterson is giving a lot of attention to some current experiments on new types of shell cases. And when he has a moment to spare, he allows himself the luxury of thinking of the splendid things Auto-Lite is going to be able to do with this hard-earned technology when the time comes that America once again can draw steel for peace instead of war.

Guadalcanal Interview

IN THE steaming hell of Guadalcanal and New Guinea, it's *"Fire less and fire better!* The fighting is savage. There is no quarter. It's kill or be killed. And the rifle is the *dominant weapon.* The need is for calm, cool, deadly shooting, sometimes at vague targets. In other words, it's men who *know their rifles*—and know what they will do. Out here, the accent is on *aimed fire.* We have to go back to the days of Rogers' Rangers . . . when every man made every shot count!"

(*From an interview with an army observer on Guadalcanal, in the March 1943 issue of* The American Rifleman.)

If you and your .22 want to "go to war" for Uncle Sam, here's how you can do it! Join your local rifle club and help teach marksmanship to men who may enter the Services—or some *auxiliary* service. This instruction may save their lives in days to come. And the need is urgent . . .

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So . . . share your rifle with your neighbor, under the NRA training program. Ammunition is made available by interested government departments through the National Rifle Association. *Join or start,* a local rifle club—*now!*

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Diamonds by the Ton

(Continued from page 109)

Quite recently, experts of the National Bureau of Standards have perfected a highly precise method of comparison. They test mineral hardness by observing the length of a lozenge-shaped dent in a specimen, produced by applying a diamond point, mounted on a weighted bar, for a measured number of seconds. Similar instruments have long been used for testing metals, but the new one makes such a microscopic impression that it will not shatter fragile crystals. Nevertheless the dent can be measured with accuracy, because of its elongated shape.

For comparing minerals high on the hardness scale—and therefore of most interest to users of abrasives—a wear test resembling practical use has been independently developed by Charles E. Wooddell, research engineer of the Carborundum Company. First he embeds samples of the different materials in a disk of resin, and smooths their projecting surfaces until all stand out exactly equally. Then he rotates the disk in a lap grinder, where abrasive grain in water wears down the projections for about two minutes. Simply by measuring the differences in height of the worn samples, he finds how they compare in resistance to wear.

Strange lore about diamonds applies equally to gem and industrial stones. Like coal and graphite, a diamond is a form of carbon, and textbooks say it will burn. Just to check up, the Dessaus once applied a blowtorch to a diamond valued at $165. The three-carat stone turned black and flaked away. But the experiment was well worth its cost. It showed the care required in handling a torch, to solder a diamond on a tool—and also what can happen to a diamond if it is carelessly overheated in use.

Sir C. V. Raman, famed research worker in India, probably ranks as the world's leading experimenter with diamonds—a field that few scientists can afford to explore. Winner of a Nobel prize, he expended the award to acquire more than 200 of the jewels for his laboratory. Recently he proved that a diamond glows under ultraviolet rays of its own accord, and not because of impurities, as previously supposed. With the aid of 20 young assistants, he is probing into the mysteries of diamond crystals and the behavior of their atoms, using such tools as X rays, black light, spectroscopes, and polariscopes. Out of his study, he predicts, may evolve a fundamental theory of the solid state of matter that will revolutionize the science of physics.—ALDEN P. ARMAGNAC.

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The Flat-Top Carries On

(Continued from page 117)

aircraft carrier depends largely upon the number of planes it can operate. Large U. S. carriers, including the *Essex* class, employ about 80 planes apiece—considerably more than the biggest carriers of foreign powers, and about twice as many as our "pocket carriers" and converted merchantmen.

A novice's first glimpse of an aircraft carrier centers upon its most distinctive feature—its great flat top, the flight deck where its planes soar aloft and land. To keep this space clear of obstructions and free from turbulent, hot gases from the funnels, curious expedients have been tried. The U.S.S. *Ranger* was built with three stacks on each side, arranged to swivel so that they could be swung horizontally outboard during flight-deck operations. Some Japanese carriers employ variations of the scheme. Most modern carriers, however, combine the funnels with the superstructure in an "island" at the side of the ship.

Before dawn, on sea duty, giant elevators bring planes up to the flight deck from the hangar deck below. The planes are spotted on the deck in the order of the take-off run they require—fighters nearest the bow; dive bombers (which double as scouts) amidships; torpedo bombers, armed with torpedoes or with heavy bombs, toward the stern. Heaviest of the carrier's planes, they need most of the length of the deck to get into the air.

This is action, not a routine patrol, as the commanding officer has explained to squadron leaders the evening before. All night long, the carrier's turbines have been driving the high-speed ship toward the objective, which at 5 a.m. is 160 miles away—direction, E.N.E. The planes are to attack two cruisers in a harbor, and to destroy shore installations.

Coffee in the ready room. Above the roar of motors warming up, the "bull horn" or ship's loudspeaker booms final orders. One after another, the planes smoothly take off and form into squadrons.

Over their low-powered interplane radios, pilots converse as they approach and attack the target, using fanciful nicknames to identify their combat teams. Back in the carrier's radio room, powerful amplifiers pick up a running account of the fight.

"Margie to Jean. Cruisers sighted near west cape."

"Margie acknowledged. Will take nearest cruiser."

"O.K., Jean. Far ship ours. Lona getting fuel tanks."

"Jean to carrier. Mission accomplished."

Now the victorious planes—some bullet-riddied, some scarred with flak—speed back to a pre-arranged rendezvous. Here they form a "landing circle"—a merry-go-round approach to the stern of the carrier, which is heading into the wind to shorten their landing run. If several squadrons are aloft, the landing circle has separate levels, the top one coming in last.

Near the stern of the flight deck stands the landing signal officer, directing the level or direction of each pilot's approach with signal paddles. His command is law. If he gives the signal not to land, the pilot must go back to the start of the landing circle and try again. If he is permitted to alight, a secret arresting device engages a hook under the plane and brings it to an abrupt halt, giving the pilot a sensation not unlike that of a sudden but smooth stop in a high-speed elevator. Like football players, the plane handlers make a flying tackle to disconnect the hook and get the plane out of the way before the next one alights on the flight deck.

How quickly a carrier can take aboard its returning planes, rearm and refuel them, and get them in the air again may win or lose a battle. Working at the speed of pit men in an automobile race, highly trained airplane handlers can make one carrier do the normal job of two. During the landing of Allied invasion forces in Africa, under cover of an aerial umbrella, a U. S. carrier is reported to have set a world's record for take-offs and landings. Hitler and Tojo will not get the figures here. But it is no official secret that landing one plane a minute for an hour or more—a phenomenal performance for a first-class airport—would be considered slow aboard any aircraft carrier in any navy in the world.

Two carriers are more than twice as effective as one. Fighter planes from one can screen the pair defensively, while all other planes carry out an attack. Amateur tacticians may find it interesting to speculate upon the possibility of combat groups of three or more carriers, each perhaps specialized to handle one particular type of plane.

In case a returning pilot finds his carrier has been sunk, he simply alights on the deck of another one. But he had better be more careful than certain Japanese pilots to make sure that the carrier is fighting on his side.

Subscribers in the armed services who notify us of change of address are requested to give us the key symbols appearing on the wrapper in which the magazine is received.

The Facts About Radar

(Continued from page 70)

than either had before. Since that time, at any rate, our radar design has been improved many times.

Results speak louder than theories. In the South Pacific alone, radar has cost the enemy millions of dollars' worth of surface ships, airplanes, and submarines. One instance of action in this area is cited by Frank B. McIntosh, director of the radio and radar division of the War Production Board:

"In the dead of night an American warship was scanning the horizon. It detected an enemy vessel between 20,000 and 30,000 yards away. It fired one salvo. The object disappeared. Probably the enemy never knew what hit it."

In a three-month period of the African campaign, when radar was used against Axis night-flying planes, it destroyed 120 of them and also scored 50 to 60 "probables," according to Brig. Gen. W. L. Richardson. Just back from Africa, Gen. Dawson Olmstead, Chief Signal Officer of the Army, confirms the efficacy of American and British radar equipment there. The air-raid warning equipment, put into service as soon as possible after the original landings, spotted enemy planes at great distances. Consequently our own air forces could frequently repel them before they got near our installations.

Why Germany, reported to have an inferior form of radar, failed to push its development deserves speculation. To reach targets within German borders, British raiders would have to cross a vast expanse of Europe. Presumably the sound of their motors could be picked up by acoustic listening devices of standard design all along the way, and warning could be flashed ahead to the target area long before they got there. What need, then, of radar? Further, German reasoning may well have run, the British must have considered themselves equally immune, until the sudden fall of France put German bomber bases right across the Channel. What could be sweeter than to swoop in from the sea and rain destruction upon a city too near the coast to receive an alarm in time? The surprise was on the Germans, however, when Britain's intensively developed radar picked them up far at sea, and they faced anti-aircraft guns that were shooting to kill instead of scattering a random barrage of flak. Now that Germany is the target, her radar technicians must be trying desperately to make up for lost time.

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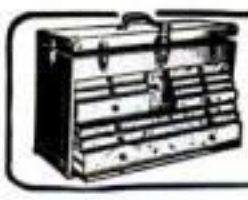

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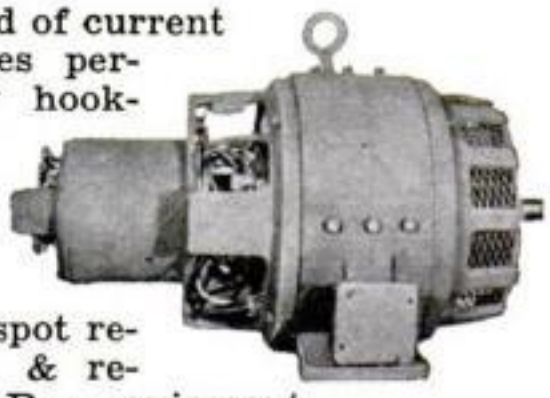

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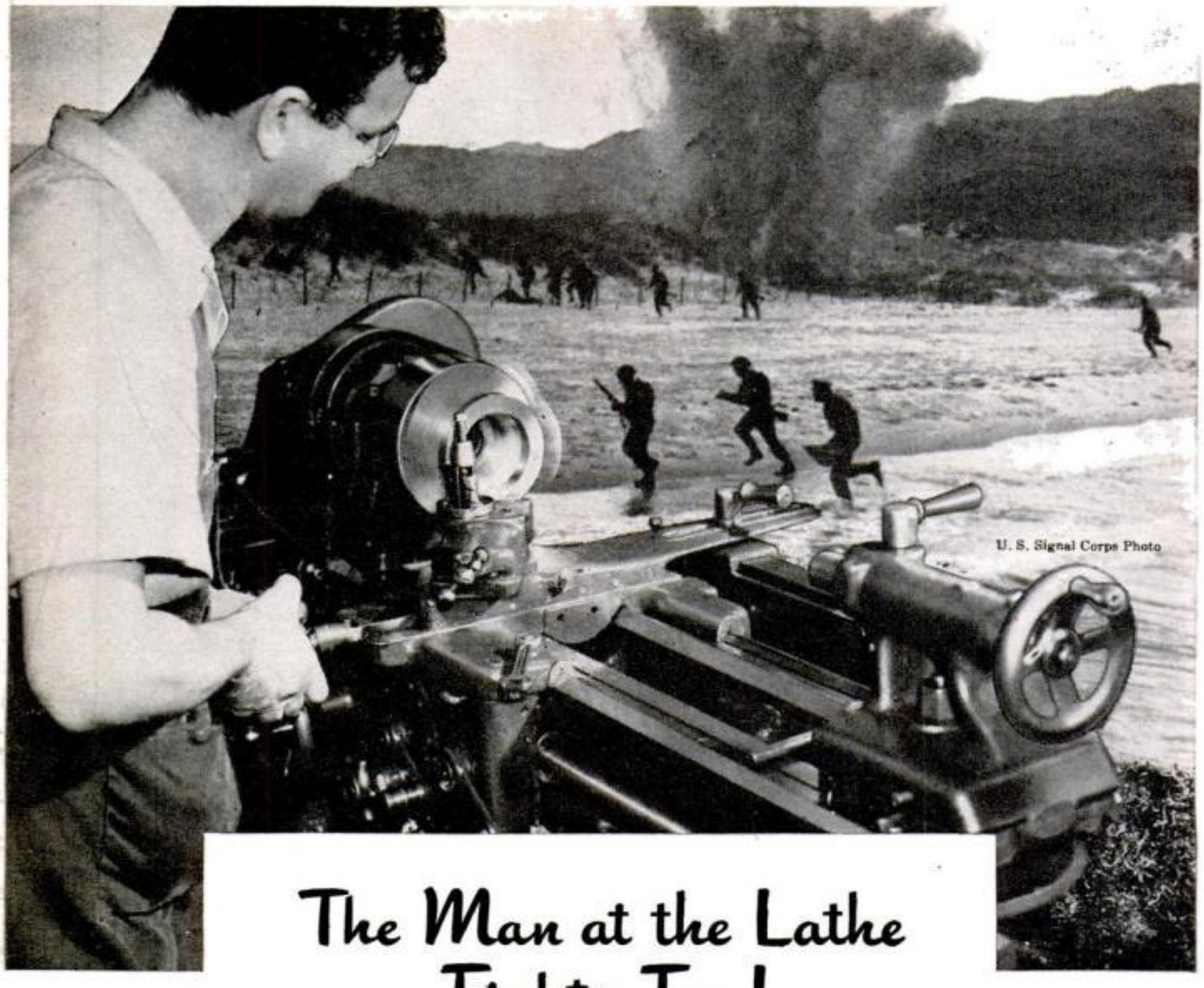

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